

**TM 3-4410-201-12**

**DEPARTMENT OF THE ARMY TECHNICAL MANUAL**

---

**OPERATOR AND ORGANIZATIONAL  
MAINTENANCE MANUAL**

**HEATER, WATER, LIQUID FUEL,  
SKID-MOUNTED, 600 GHP, M2**

---

This reprint includes all changes in effect at the time of publication - Changes 3 and 4.

---

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
JANUARY 1969**

## **WARNINGS**

An operator must be in attendance at all times during operation of the M2 water heater.

Water must be circulating through the M2 water heater before the fuel is ignited, as well as throughout the time the M2 water heater is operating, in order to keep from damaging the equipment.

If possible, do not operate the M2 water heater in an inclosed area. The M2 water heater must be placed outside the inclosed area, or the exhaust gases must be vented outside the inclosed area, to prevent carbon monoxide poisoning. Wearing the field protective mask does not protect the wearer against carbon monoxide fumes from the M2 water heater exhaust stack.

Make certain that the fuel supply and fuel return lines are properly connected before operating the M2 water heater.

Circulate only fresh water through the M2 water heater to avoid damage to the M2 water heater.

Do not attempt maintenance other than visual inspection during M2 water heater operation. Water and fuel lines are pressurized, and water temperatures may be as high as 188° F. to 212° F. Failure to comply may result in serious injury to personnel.

Keep clear of exhaust stack during operation of the M2 water heater.

Make sure that the main power cable is disconnected from the single pin plug receptacle on the M decontaminating apparatus prior to performing inspection and servicing of electrical motors, control panel, and rotating parts on the M2 water heater.

When removing any of the fuel system components, disconnect the main power cable from the power source. Do not smoke or use open flame in the vicinity. Take care to avoid spilling fuel. Wipe up any spilled fuel immediately.

If possible, do not attempt to disconnect the inlet water hose with temperatures indicated in excess of 100° F. If it is necessary to disconnect the inlet water hose while the water temperature in the low-pressure heating boiler is above 100° F., exercise extreme care to prevent scalding. When the inlet water hose is disconnected, the low-pressure heating boiler drains completely.

Change }  
No. 3 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
Washington, D.C., 12 June 1978

**Operator's and Organizational Maintenance Manual**  
**HEATER, WATER, LIQUID FUEL,**  
**SKID-MOUNTED, 600 GPH, M2**  
**FSN 4410-542-5656**

TM 3-4410-201-12, 31 January 1969, is changed as follows:

The title of this manual is changed as shown above.  
*Page 3*, paragraph 1-4b. The last sentence is changed to read as follows:

The mechanically rotated combustion ignition magneto generates and supplies independent electric power to the ignition plug through the ignition cable assembly. The ignition plug ignites the fuel in the combustor assembly (11, fig. 1-2).  
*Page 5*. "Figure 1-3" is changed to read "Figure 1-4."

*Page 6*. "Figure 1-4" is changed to read "Figure 1-3."

*Page 7*, paragraph 1-6c. In line 5, "600 + 10) gph" is changed to read "600 (+ 10) gph."

*Page 12*, paragraph 2-7d. In line 2, "media" is changed to read "modes of transportation."

*Page 14*, paragraph 2-15. In line 1, "rubbe" is changed to read "rubber."

*Page 22*, paragraph 3-23. In line 14, "Sotre" is changed to read "Store."

*Page 25*, paragraph 4-5b. In line 6, "(VV-F-8152)"

is changed to read "(VV-F-815a)."

*Page 27*, paragraph 4-14. In line 9, "Replace the broken drive arm (para 4-36d)" is changed to read "Report to direct support maintenance personnel."

Paragraph 4-15. In line 25, "Replace the broken drive arm (para 4-36d)" is changed to read "Report to direct support maintenance personnel."

*Page 31*, paragraph 4-24d (2). Italicize the title of paragraph 4-24d (2) as follows:

(2) *Installation of TD-1 or TD-2 time delay relays.*

*Page 36*. Paragraphs 4-36d (1) and (2) are deleted.

*Page 41*, Appendix A, References. TM 9-213 is reinstated.

*Page 46*, Section II, Maintenance Allocation Chart. In line 15, column (5), delete "O authorized to replace shaft arms."

In line 18, column (5), delete "O authorized to replace shaft arms."

*Pages 42 through 44. Appendix B is superseded  
as follows:*

## **APPENDIX B** **BASIC ISSUE ITEMS LIST AND ITEMS** **TROOP INSTALLED OR AUTHORIZED LIST**

### **Section I. INTRODUCTION**

Not required.

### **Section II. BASIC ISSUE ITEMS LIST**

There are no basic items for the M2 water heater.

### **Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST**

There are no items troop installed or authorized for the M2 water heater.

By Order of the Secretary of the Army:

Official:

**CREIGHTON W. ABRAMS**  
*General, United States Army*  
*Chief of Staff*

**VERNE L. BOWERS**

*Major General, United States Army*  
*The Adjutant General*

Distribution:

To be distributed in accordance with DA Form 12-28, (qty rqr block no. 45) Organizational maintenance requirements for Skid-Truck Mounted, Decomtaminating Apparatus.

TM 3-4410-201-12  
C 4

CHANGE }  
No. 4 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC, 29 March 1977

**Operator's and Organizational Maintenance Manual  
HEATER, WATER, LIQUID FUEL, SKID-MOUNTED  
600 GHP, M2  
(NSN 4410-00-542-5656)**

TM 3-4410-201-12 31 January 1969, is changed as follows:

*Page 25, Para 4-8, b, Line 2.* "weekly or monthly" is changed to read "quarterly".

*Page 25, Para 4-8, b, Line 8 thru 12.* Change to read "Quarterly services must be performed quarterly or after 240 hours of operation, whichever occurs first".

*Page 25, Table 4-1.* "Weekly and Monthly Schedule"

is changed to read "Quarterly — Schedule".

*Page 25, Table 4-1, Interval and Sequence No.* "Weekly, Monthly" is changed to read "Quarterly" number sequence will remain as the Weekly Schedule is at present which continues to page 26.

*Page 26, Table 4-1, Cont, Interval and Sequence No.* "Weekly, Monthly" is changed to read "Quarterly".

By Order of the Secretary of the Army:

Official:

BERNARD W. ROGERS  
General, United States Army  
Chief of Staff

PAUL T. SMITH  
Major General, United States Army  
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-28, Operator maintenance requirements for Water Heater-



TECHNICAL MANUAL  
No. 3-4410-201-12

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D.C., 31 January 1969

## Operator and Organizational Maintenance Manual

### HEATER, WATER, LIQUID FUEL, SKID-MOUNTED, 600 GPH, M2

	Paragraph	Page
<b>CHAPTER 1. INTRODUCTION</b>		
Section I. General	1-1—1-3	2
II. Description and data	1-4—1-6	2
<b>CHAPTER 2. OPERATING INSTRUCTIONS</b>		
Section I. Controls and instruments	2-1—2-6	10
II. Operation under usual conditions	2-7, 2-8	12
III. Operation of materiel used in conjunction with M2 water heater	2-9—2-13	13
IV. Operation under unusual conditions	2-14—2-17	14
<b>CHAPTER 3. OPERATOR'S MAINTENANCE INSTRUCTIONS</b>		
Section I. Special tools and equipment	3-1, 3-2	15
II. Operator's preventive maintenance services	3-3—3-7	15
III. Operator's troubleshooting chart	3-8—3-11	18
IV. Cover panels	3-12, 3-13	19
V. Water temperature, fuel, and water pressure gages	3-14, 3-15	19
VI. Main electrical power cable	3-16, 3-17	21
VII. Fuel hose assembly	3-18, 3-19	21
VIII. Fuel and water pressure lines	3-20, 3-21	22
IX. Water hose assembly	3-22, 3-23	22
X. Identification plates	3-24, 3-25	22
XI. Heat-reflective pressure-sensitive adhesive tape and painting	3-26, 3-27	23
<b>CHAPTER 4. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS</b>		
Section I. Service upon receipt of equipment	4-1, 4-2	24
II. Painting	4-3, 4-4	24
III. Organizational preventive maintenance instructions	4-5—4-8	25
IV. Organizational troubleshooting chart	4-9—4-16	26
V. Side, end, and front panels	4-17, 4-18	27
VI. Tool carrier	4-19, 4-20	28
VII. Control box cover plate	4-21, 4-22	28
VIII. Control box assembly	4-23, 4-24	29
IX. Water hose assembly	4-25, 4-26	31
X. Fuel hose assembly	4-27, 4-28	33
XI. Main electrical power cable	4-29, 4-30	33
XII. Low-pressure heating boiler	4-31, 4-32	35
XIII. Heat-reflective pressure-sensitive adhesive tape	4-33, 4-34	36
XIV. Skid assembly	4-35, 4-36	36
<b>CHAPTER 5. SHIPMENT, ADMINISTRATIVE STORAGE, AND DEMOLITION TO PREVENT ENEMY USE</b>		
Section I. Shipment and administrative storage	5-1, 5-2	39
II. Demolition to prevent enemy use	5-3, 5-5	39
<b>APPENDIX A. REFERENCES</b>		<b>A-41</b>
B. BASIC ISSUE ITEMS		B-42
C. MAINTENANCE ALLOCATION		C-45
<b>INDEX</b>		47

\*This manual supersedes TM 3-4410-201-12, 30 July 1965, including all changes.

## CHAPTER 1

### INTRODUCTION

---

#### Section I. GENERAL

##### 1-1. Scope

This manual is published for the use of the operator (or crew) and the organizational maintenance personnel responsible for the operation and maintenance of the Heater, Water, Liquid Fuel, Skid-Mounted, 600 GPH, M2. This manual contains operation and maintenance instructions as well as a description of the major units and their functions in relation to the other components of this equipment. Hereinafter this equipment shall be referred to as the M2 water heater. The M2 water heater instructions in this manual are for use with the M9 decontaminating apparatus (TM 8-4230-203-12). TM 8-4230-209-12 contains M2 water heater operator and organizational maintenance instructions for use with the M12A1 decontaminating apparatus.

##### 1-2. Record and Report Forms

a. Use the appropriate record and report forms prescribed in TM 38-750.

b. Use DA Form 6 (Report of Damage or Improper Shipment) to report damaged or improper shipment of materiel.

c. The reporting of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding Officer, Edgewood Arsenal, ATTN: SMUEA-TSE-TP, Edgewood Arsenal Md. 21010.

##### 1-3. Allocation of Maintenance

Refer to the maintenance allocation chart (app. C) to determine maintenance services authorized for organizational maintenance personnel. Report any maintenance requirement beyond the scope of organizational to direct support maintenance personnel.

---

#### Section II. DESCRIPTION AND DATA

##### 1-4. Description

a. General. The M2 water heater (fig. 1-1) is a fully inclosed, skid-mounted unit used to raise the temperature of water flowing through a multi-fuel-fired, low-pressure heating boiler. Refer to tabulated data (para 1-6) for the types of fuel that may be used. Using water of +35° F to 85° F, the M2 water heater boiler will raise the water temperature at least 100° F. within 5 minutes, when the water is flowing at a rate of 600 ( $\pm 10$ ) gallons per hour (gph). Functionally, the M2 water heater consists of the fuel and ignition system, the combustion system, and the control system.

Note. The electrical system of the M2 water heater is basically a 24-vdc electrical system. When operating with the generator-voltage regulator, the equipment is operating with 28 vdc. When operating from battery power, the equipment is operating with 24 vdc.

b. Fuel and Ignition System. The operating components of the fuel and ignition system are a fluid pressure filter, fuel pump, fuel and ignition drive motor B2 (9, fig. 1-2), combustor ignition magneto, and fuel pump solenoid valve L1 (10), all of which are installed in the skid assembly. The fuel and ignition drive motor B2 operates on 24- to 28-vdc electrical power from an external source. The fuel and ignition drive motor B2 drives the fuel pump and the combustor ignition magneto. A fluid pressure filter, which is located between the external fuel supply and the fuel pump, is used to remove foreign particles and suspended ice crystals from the fuel. The fuel pump sucks the fuel through the fuel hose into the fluid pressure filter, then into the fuel pump, and drives the fuel under constant pressure out of the fuel pump. When the heater control switch S4 (13) is in the PURGE ON position, the fuel pump



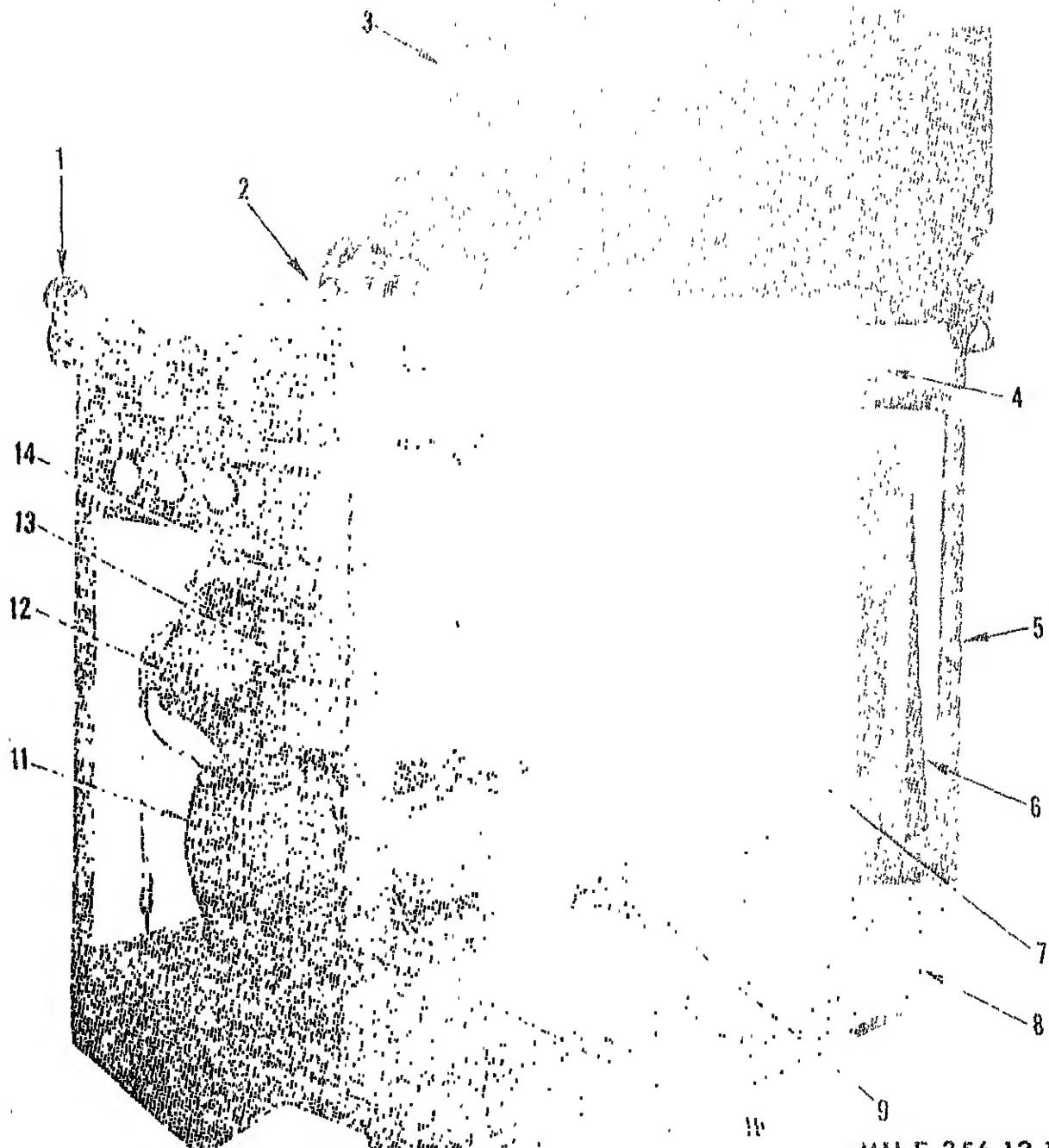
MU-E-356.12-1.1

Figure 1-1. M2 600 gph skid-mounted liquid fuel water heater.

solenoid valve L1 (10) is open. The entire output of fuel from the fuel pump passes through the fuel pump solenoid valve L1 and is returned to the external fuel supply. When the heater control switch S4 is in the HEATER ON position, electrical power energizes the magnetic coil of the solenoid valve L1, closes solenoid valve L1, which closes off this route for the passage of fuel. Fuel is then pumped through other tubing to the combustion nozzle, where part of it is sprayed into the combustor assembly. The remainder of the fuel is bypassed by the temperature selector valve and returned to the external fuel supply. A portion of the fuel is cycled within the fuel pump itself. The

mechanically rotated combustor ignition magneto generates independent electrical power to the combustor ignition plug in the combustor assembly, where the spark ignites the fuel.

c. Combustion System. The operating components of the combustion system are the combustion air blower motor B1 and mounting assembly (12, fig. 1-2), combustor assembly (11), low-pressure heating boiler (7), refractory box (6), and exhaust stack. The combustion system uses forced air from the combustion air blower motor B1 and an atomized fuel mixture. This mixture is introduced into the combustor assembly, where it is ignited by the combustor ignition plug. The



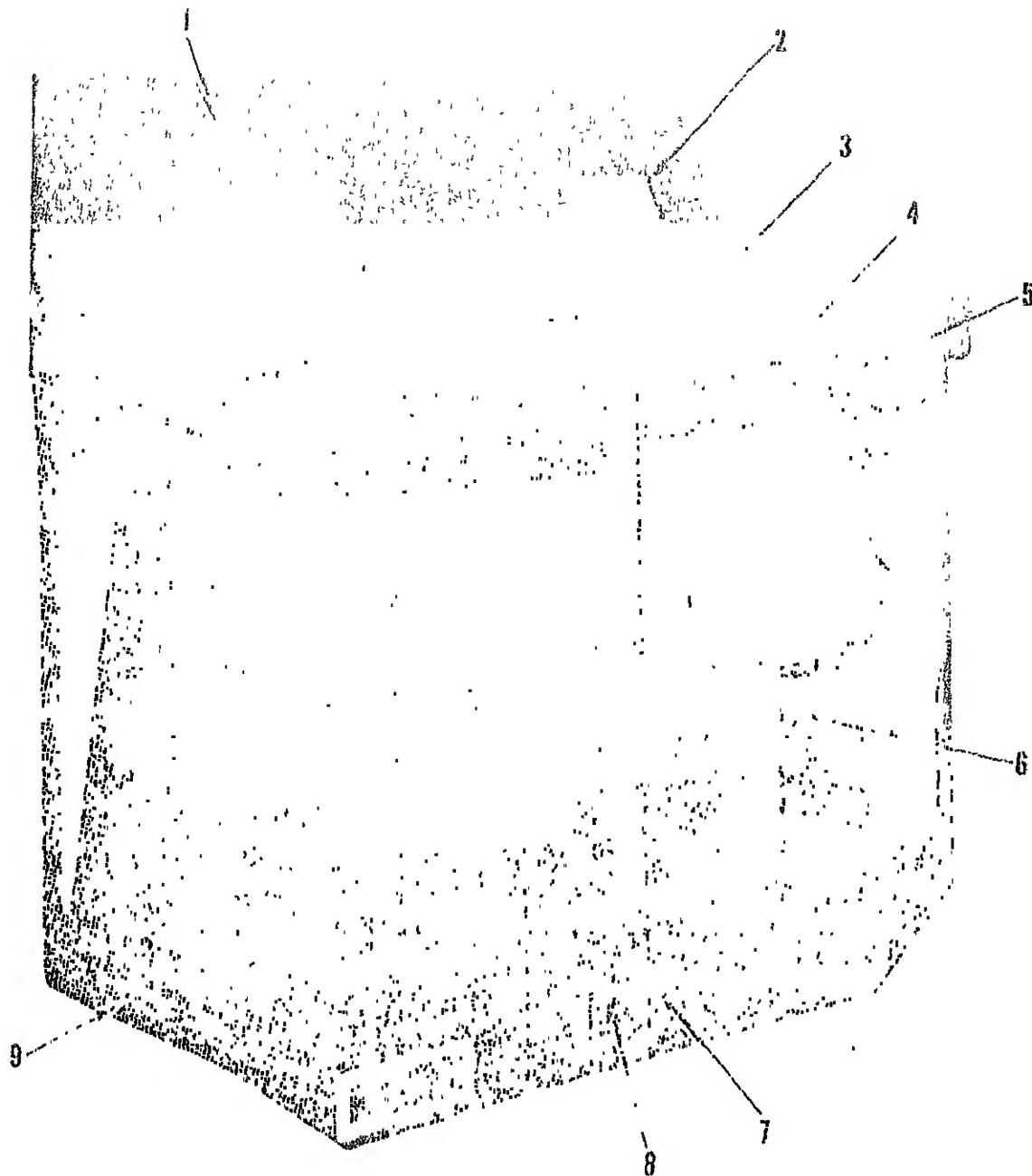
MU-E-356-12-1.2

- |                                      |                                    |                                   |
|--------------------------------------|------------------------------------|-----------------------------------|
| 1 Lifting eye assembly (clevis)      | 5 Cabinet frame                    | 11 Combustor assembly             |
| 2 Door stop assembly                 | 6 Refractory box                   | 12 Combustion air blower motor B1 |
| 3 Cabinet top cover                  | 7 Low-pressure heating boiler      | and mounting assembly             |
| 4 Hose and cable storage compartment | 8 Skid assembly                    | 13 Heater control switch S4       |
|                                      | 9 Fuel and ignition drive motor B2 | 14 Temperature selector valve     |
|                                      | 10 Fuel pump solenoid valve L1     |                                   |

Figure 1-2. M2 water heater, left-front view, cover panels removed.

flame, once established, is self-sustaining. Cold water enters the bottom of the low-pressure heating boiler, and heated water leaves through the

water hose at the top of the low-pressure heating boiler. The burning fuel-air mixture is driven through the boiler and turned by the refractory



MU-E-356-12-1-3

Figure 1-3. M2 water heater, right-rear view, cover panels removed.

box into the turbulated tubing, where the bulk of the heat exchange takes place. The exhaust stack directs the exhaust out of the M2 water heater.

*d. Control System.* The control system consists of operating controls, temperature and pressure gages, electrical controls, and safety devices that provide fail-safe operation. The temperature selector controls the amount of fuel sprayed into

the combustor assembly. The heater control switch operates the electrical controls that direct the fuel through the nozzle lines to spray fuel in the combustor assembly (heater on) or to bypass all fuel back to the supply (purge on). The water pressure gage indicates the pressure at which water is provided by the external source. The fuel pressure gage indicates the pressure of the

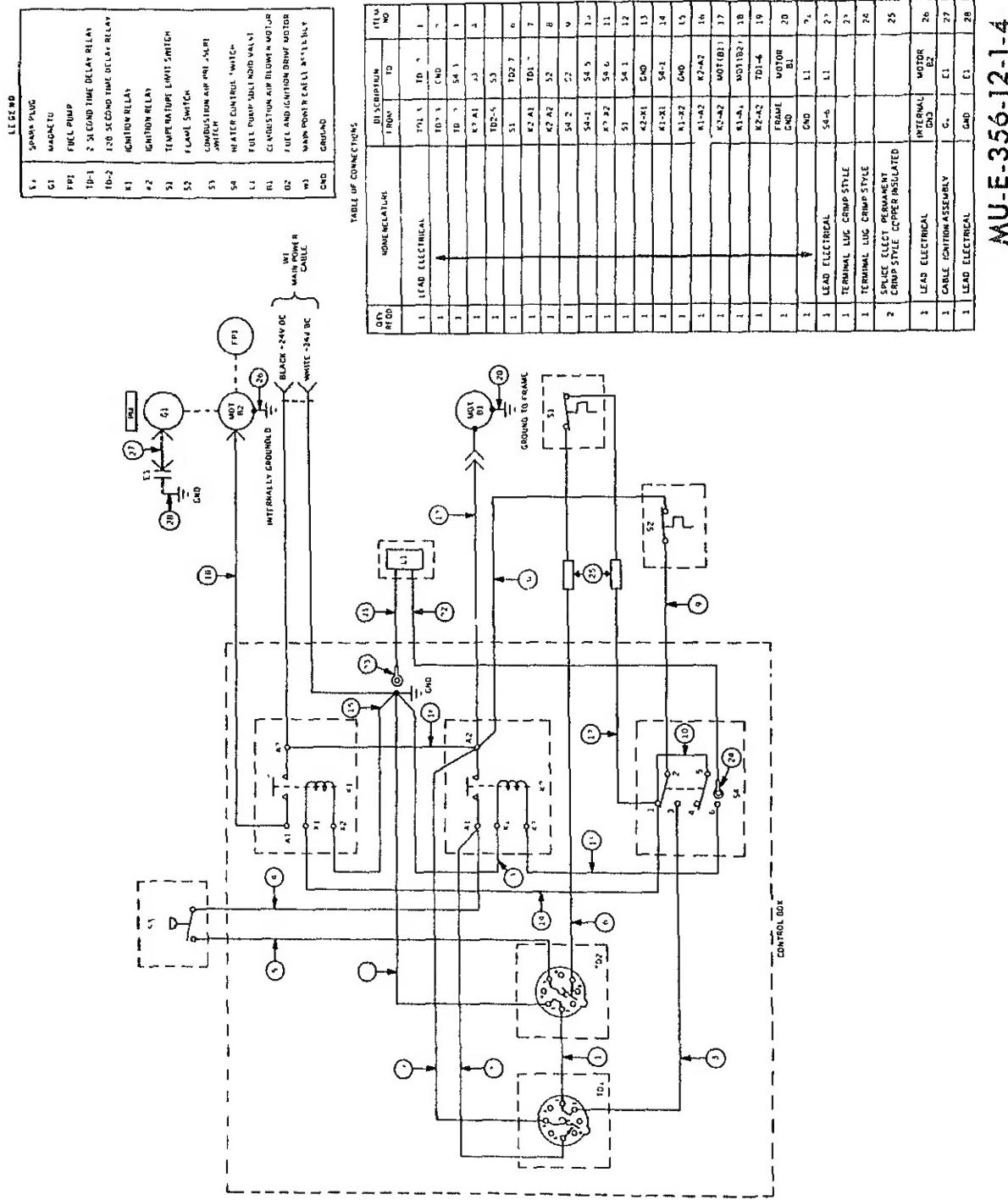


Figure 1-4. M2 water heater electrical schematic, legend, and table of connections

MU-E-356-12-1-4

1 Tool carrier  
2 Exhaust warning plate  
3 Door stop assembly

4 Main electric power cable  
5 Water hose  
6 Safety relief valve  
7 Fuel return line dust cap

8 Fuel supply line dust cap  
9 Cold water inlet pipe chain and dust cap

Figure 1-4—Continued.

fuel at the temperature selector valve. The water temperature gage (through an integral capillary tube) indicates the discharge or heater water temperature. The automatic fail-safe devices are installed throughout the M2 water heater to insure optimum operation at all times. Figure 1-3 shows an electrical schematic diagram of the fail-safe devices.

c. *Accessories.* Accessories consist of the water hose (5, fig. 1-4), electric main power cable (4), fuel hose, and tools. The two-piece water hose is coupled to the water outlet pipe at the top of the low-pressure heating boiler. The W1 main power cable assembly (fig. 1-3) is connected by one end to the control box, and the free end is to be connected to an external 24- or 28-vdc power source, such as the receptacle connector on the M9 decontaminating apparatus (TM 3-4230-203-12). The fuel hose provides supply and return lines between the external fuel supply (5-gallon gasoline can) and the M2 water heater. The tools are provided for use with the M2 water heater as required.

### 1-5. Identification

The nameplate, operating instructions, and identification plates for the gages, temperature selector, and heater control switch are located on the front of the M2 water heater. A warning decal is on the inside surface of the cabinet top cover. Figure 1-5 shows these identification plates, as well as component plates.

### 1-6. Tabulated Data

The following data are approximate.

#### a. General Dimensions and Weight.

##### *Uncrated.*

Height	- - -	43 in.
Width	- - -	21 in.
Length	- - -	53 in
Weight	- - -	575 lb
Cube	- - -	22 cu. ft

#### b. Capacities.

Maximum fuel consumption rate	6 gph
Maximum liquid temperature	188° F to 212° F.
Maximum operating water pressure	180 psi
Electrical operating voltage	24 to 28 vdc

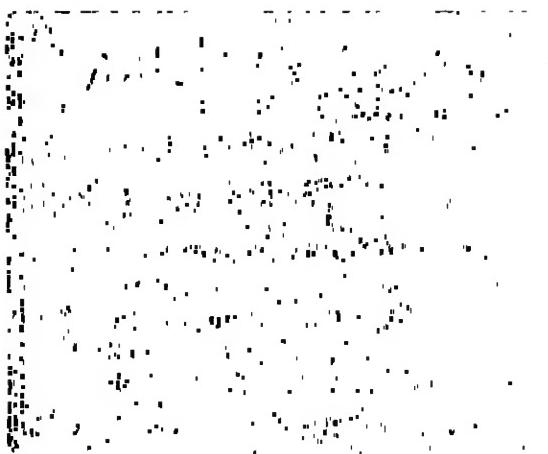
*Note.* The fuel, water, and electrical power must be supplied from external sources.

c. *Performance.* Using water with temperature between 35° F and 85° F, the M2 water heater will raise the water temperature at least 100° F within 5 minutes when the water is flowing at a rate of 600° ( $\pm 10$ ) gph.

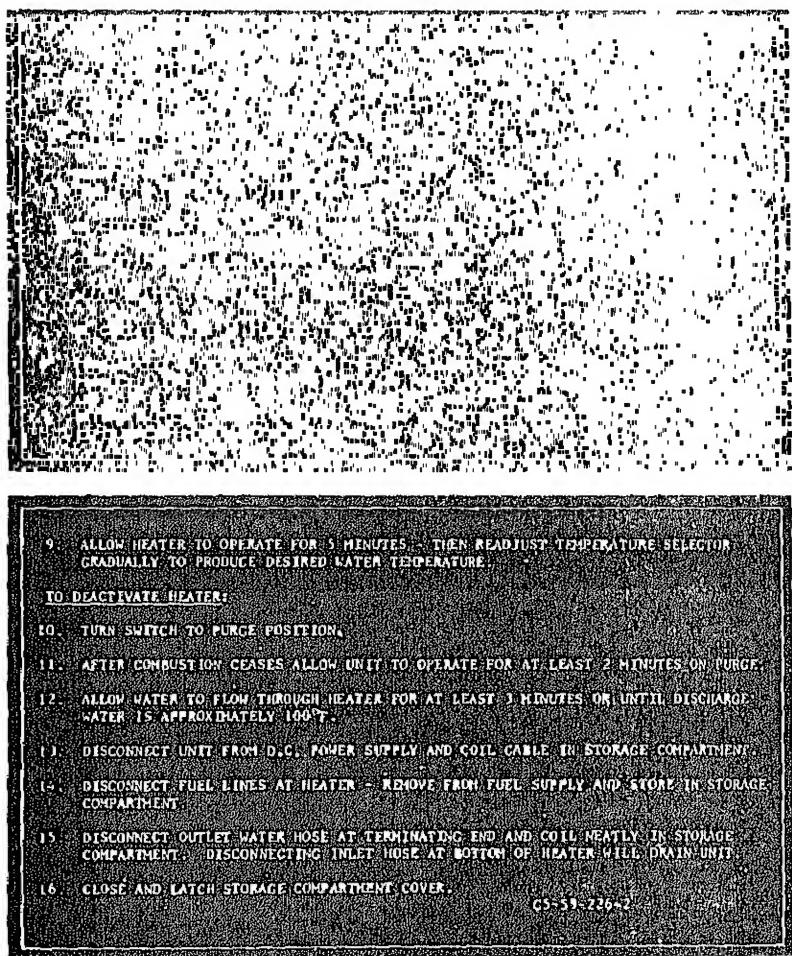
d. *Types of Fuel.* The M2 water heater has a multifuel capability. The four fuels authorized for use are combat automotive gasoline, type I (MIL-G-3056B); jet fuel, grade JP-4 (MIL-J-5624F); kerosene (VV-K-211d); and burner fuel oil, grade No. 2 (VV-F-815a).

#### e. Component Information.

Ignition plug, combustor	- - -	FSN 2920-580-3435
Gap	- - -	5/32 in.
Size	- - -	18 mm.
Combustion air blower motor	- - -	FSN 6105-608-0533
rpm	- - -	6,350
Direct current motor (fuel and ignition drive motor)	- - -	FSN 6105-881-0553
rpm	- - -	2,100
5-gallon gasoline can	- - -	FSN 7210-222-3088



A. M2 WATER HEATER NAMEPLATE



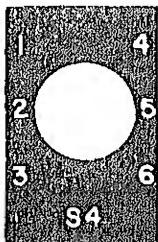
B. OPERATING INSTRUCTIONS PLATES ( 2 parts )

MU-E-356-12-1-5 ①

Figure 1-5. Identification plates.



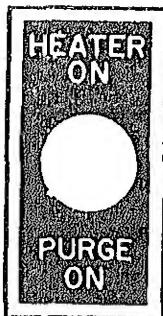
C. ELECTRIC DRIVE MOTOR  
IDENTIFICATION PLATE



D. S4 TERMINAL PLATE



E. TEMPERATURE SELECTOR  
PLATE



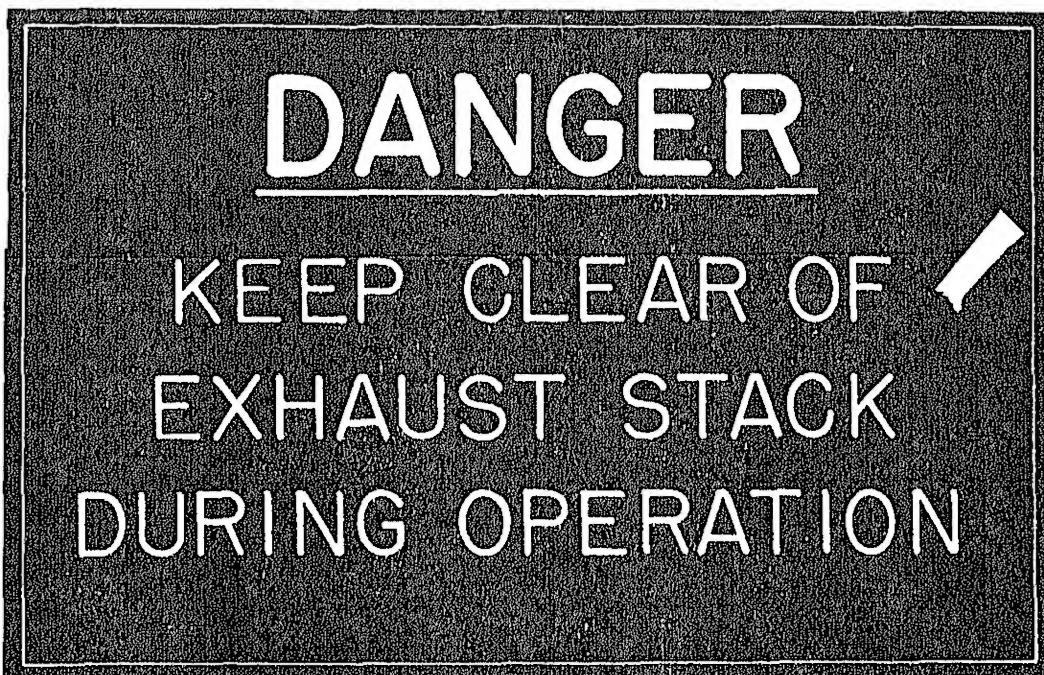
F. HEATER ON PURGE  
ON SWITCH PLATE



G. RELAY AND TIMER PLATES

WATER PRESSURE FUEL PRESSURE WATER TEMPERATURE

H. GAGE IDENTIFICATION PLATE



I. WARNING PLATE

MU-E-356-12-1-5 (2)

*Figure 1-5—Continued.*

## CHAPTER 2

### OPERATING INSTRUCTIONS

#### Section I. CONTROLS AND INSTRUMENTS

##### 2-1. General

This section describes, locates, and gives the purpose of the various controls and instruments (fig. 2-1) provided for operation of the M2 water heater.

##### 2-2. Heater Control Switch S4

a. *Description.* The heater control switch S4 (5) is a two-position toggle switch that has HEATER ON and PURGE ON positions.

b. *Location.* The heater control switch S4 is located on the M2 water heater control box.

c. *Purpose.* Functionally, the heater control switch S4 (fig. 1-3) is provided in the electrical circuit to control the operation of the M2 water heater. Placing the switch in the PURGE ON position circulates fuel through the fuel pump and back to supply. When the heater control switch S4 is placed in heater on position, fuel is sprayed into the combustor assembly, ignited, and the M2 water heater will begin to heat water. There is no off position on this switch.

##### 2-3. Temperature Selector Valve Control

a. *Description.* The temperature selector valve control (4, fig. 2-1) provides a range from 40° F to 200° F. The control includes an integral capillary tube that senses boiler temperature through a port in the low-pressure heating boiler. Pressure in the capillary tube causes a diaphragm valve to close, which limits the flow of fuel to the combustion chamber. This causes the fuel pressure to drop until the temperature has become stable at the selected temperature. When the temperature drops below the selected temperature, the diaphragm valve relaxes to allow an increased amount of fuel to flow through the fuel system, thereby raising the fuel pressure. Increasing fuel pressure increases the burning rate and results in a higher water temperature.

b. *Location.* The temperature selector valve control (4, fig. 2-1) protrudes through the front

of the M2 water heater control box. The body of the valve is in the fuel system tubing and is mounted inside the control box. A capillary tube extends from the valve body and terminates in a sensing unit in a port of the low-pressure heating boiler.

c. *Purpose.* The purpose of the temperature selector is to enable the operator to manually control the desired water temperature. Turning the knob clockwise will raise the water temperature; turning the knob counterclockwise will lower the water temperature.

##### 2-4. Water Pressure Gage

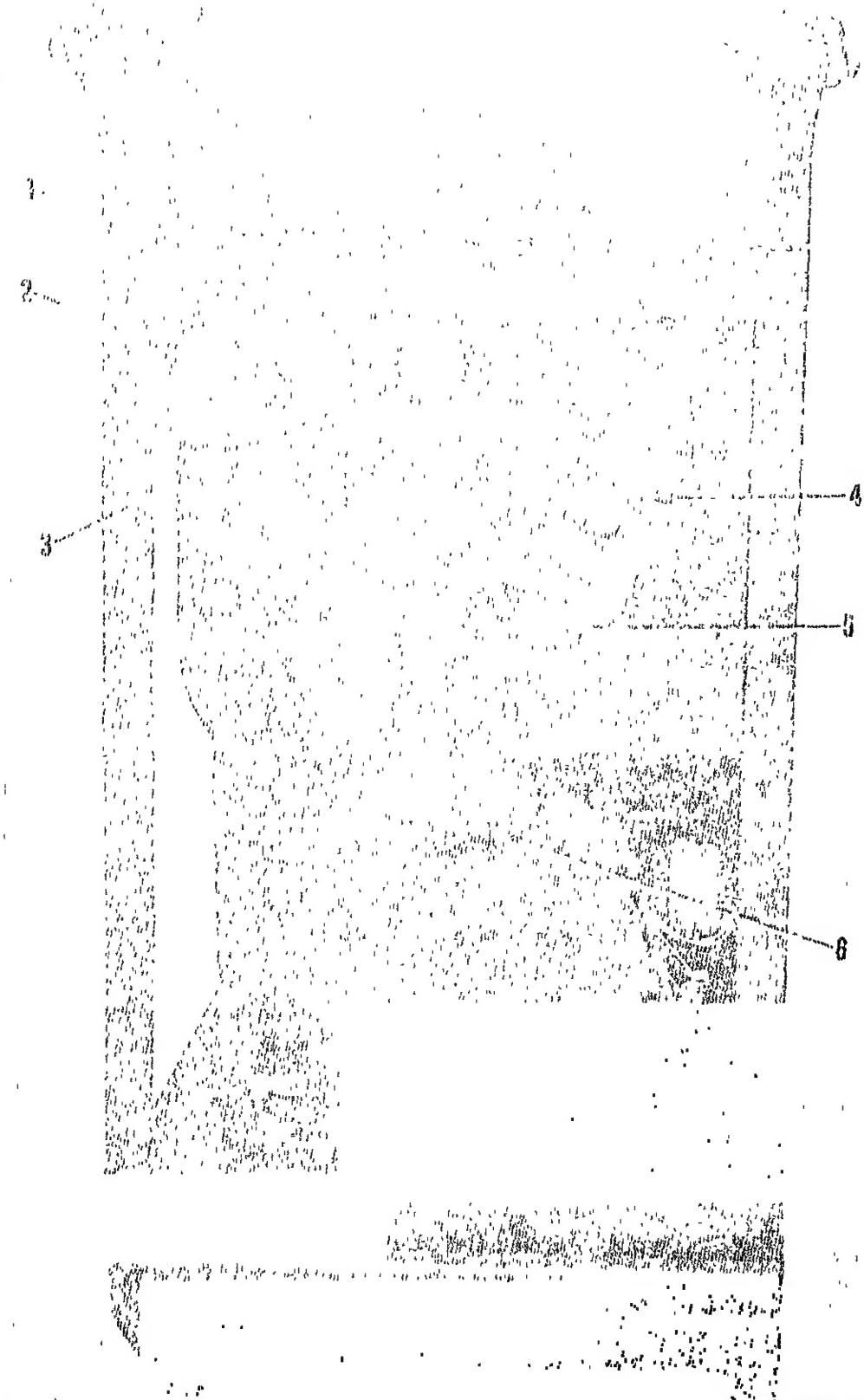
a. *Description.* The water pressure gage (2, fig. 2-1) is a flush-mounted type. A U-clamp and studs fasten the gage to the back of the control box. The gage is approximately 2.25 inches in diameter, has a plastic crystal, and is graduated from 0 to 300 psi. The figure intervals are marked at every 30 psi (i.e., 0, 30, 60, etc.), and the graduation marks are at least 10 psi. A center back connection is used to connect the gage into the water supply tubing system.

b. *Location.* The water pressure gage is located on the M2 water heater control box.

c. *Purpose.* The purpose of the water pressure gage is to indicate the pressure of the water being circulated through the low-pressure heating boiler. Normal water pressure indications are from 60 to 155 psi. At any time the water pressure indication exceeds 200 psi, the safety relief valve opens and relieves the excess pressure. The safety relief valve is self sealing.

##### 2-5. Fuel Pressure Gage

a. *Description.* The fuel pressure gage (1, fig. 2-1) is a flush-mounted type. A U-clamp and studs fasten the gage to the back of the control box. The gage is approximately 2.25 inches in diameter, has a plastic crystal, and is graduated from 0 to 160 psi. The figure intervals are marked at every 20 psi (i.e., 0, 20, 40, 60, etc.),



- 1 Fuel pressure gage  
2 Water pressure gage  
3 Water temperature gage  
4 Temperature selector valve control  
5 Heater control switch S4  
6 Single-line connector and cable assembly

Figure 2-1 Controls and instruments.

and the graduation marks are at every 5 psi. A center back connection is used to connect the gage into the fuel system tubing.

*b. Location.* The fuel pressure gage is located on the M2 water heater control box.

*c. Purpose.* The fuel pressure gage indicates the pressure of the fuel bypassing the fuel nozzle. Since the M2 water heater has a multifuel capability, different fuel atomizing pressures are required. The fuels used and the starting pressures required are as follows: combat automotive gasoline, type I, 75 psi; jet fuel, grade No. 4, 75 psi; kerosene, 70 psi, and burner fuel oil, grade No. 2, 60 psi

## 2-6. Water Temperature Gage

*a. Description.* The water temperature gage (3, fig. 2-1) is a flush-mounted type. A U-clamp and studs fasten the gage to the back of the control box. The gage is a dial-indicating-type thermometer with a capillary tube. The capillary tube connects into a port on the top of the low-pressure heating boiler. The dial is graduated from 40° F to 220° F. The copper capillary tube is 72 inches long and is covered with braided-wire sleeving.

*b. Location.* The water temperature gage is located on the M2 water heater control box.

*c. Purpose.* The water temperature gage indicates the temperature of the water within the low-pressure heating boiler.

## Section II. OPERATION UNDER USUAL CONDITIONS

### 2-7. General

*a. Scope.* This section contains instructions for operating the M2 water heater under normal conditions of climate and service. Normal conditions are considered to be operation in warm weather +50° F (+10° C) and above.

*b. Operating Personnel.* Whenever the M2 water heater is used with the M9 decontaminating apparatus (TM 3-4230-203-12), the decontaminating section personnel assume responsibility for operation of the M2 water heater. During this use, the M2 water heater is transported on the right platform of the frame support and platform assembly of the M9 decontaminating apparatus.

*c. Protective Clothing.* When performing decontaminating operations, protective clothing (TM 10-8415-204-18) and ABC-M17 field protective masks (TM 3-4240-202-15) must be worn by all operating personnel. When the M2 water heater is used to heat water for showering personnel, protective clothing and protective masks are not required.

*d. Transportability.* The M2 water heater is transportable by all media. Cross-country mobility by the M9 decontaminating apparatus is satisfactory, because the M2 water heater can be secured to the right platform of the frame support and platform assembly (TM 3-4240-203-12) to withstand travel over rough terrain. Tiedown instructions for the M2 water heater are to be included in TM 3-4230-203-12.

### 2-8. Starting, Operating, and Stopping Procedure

*a. Before-Operation Services.* Perform the operator or crew before-operation services given in

paragraph 3-4. Then place the M2 water heater on the right platform of the frame support and platform assembly (TM 3-4230-203-12).

*b. Starting Procedure.*

(1) Read the "To activate heater" operating instruction plate (B, fig. 1-5) on the front of the M2 water heater (see Note, para 1-4a).

(2) Open the storage compartment door. Remove the fuel hose and uncoil the water hose and the main electric power cable.

(3) Connect the fuel tank plug end of the fuel hose to a 5-gallon gasoline can (FSN 7240-222-3088) filled with one of the approved types of fuel (para 1-6d). The fuel tank is in the holder located back of the front fender on the driver's side of the truck (M9 decontaminating apparatus). Make certain that the open end of the fuel line inside the gasoline can is low in the container so that a maximum amount of fuel can be used. Remove the protective caps from the fuel supply and the fuel return connector halves on the skid base and connect the fuel supply and fuel return quick-disconnect halves of the fuel hose to these connector halves. Exert a pull on the connected fuel supply and fuel return lines to make certain that they are securely fastened.

(4) Remove the protective caps from the from-heater inlet pipe connection and the heater outlet pipe connection on the control panel of the M9 decontaminating apparatus. Separate the two-piece water hose. Screw the stem and shank nut end of the water hose on the heater outlet pipe connection on the M9 decontaminating apparatus control panel. Remove the protective pipe cap at the base skid of the M2 water heater. Screw a quick-disconnect coupling half (provided in the storage chest of the M9 decontaminating

apparatus) on the pipe to hose adapter end of the water hose. Connect the shank coupler to the water inlet pipe at the bottom of the M2 water heater skid. Leave the one end of the water hose connected at the top of the low-pressure heating boiler. Connect the stem and shank nut end of the water hose to the heater inlet pipe connection on the control panel of the M9 decontaminating apparatus. Tighten the threaded pipe connections with the spanner wrench from the M9 decontaminating apparatus.

(5) Remove the protective cap that protects the single-pin plug receptacle on the support plate of the hood-and-panel assembly of the M9 decontaminating apparatus. Connect the free end of the main electric power cable of the M2 water heater to it. Make certain that the main electric power cable does not pass over the exhaust stack.

**Caution:** To avoid equipment damage, water must be circulating through the M2 water heater before the fuel is ignited, as well as throughout the time that the M2 water heater is operating.

**Caution:** Circulate and heat only fresh water for use in the M2 water heater to avoid damage to the M2 water heater. Heat the water before adding chemicals, detergents, or other mixtures.

**Warning:** Keep clear of the exhaust stack during operation of the M2 water heater. Wearing the field protective mask does not protect the wearer against carbon monoxide fumes from the M2 water heater exhaust stack.

(6) Pump the M2 water heater full of fresh water; perform the applicable portion of the operating procedure for the M9 decontaminating apparatus (TM 3-4280-203-12).

(7) Make sure that procedure in (3) above is accomplished; then place the toggle switch (which is on the support plate of the M9 decontaminating apparatus) in the ON position. Make certain that the heater control switch S4 on the control box is in PURGE ON position. Operate in PURGE ON position for 2 minutes.

*c. Operating Procedure.*

(1) Place the heater control switch S4 on the control box in the HEATER ON position. Adjust the temperature selector valve control to produce an indication on the fuel pressure gage

that agrees with the fuel pressure prescribed for the type of fuel being burned (para 2-5c).

*Note.* If the M2 water heater does not ignite in 10 seconds, place the heater control switch in PURGE ON position. Do not attempt to restart the M2 water heater; notify organizational maintenance personnel. Remove electrical power by placing the toggle switch (which is on the support plate of the hood-and-panel assembly on the M9 decontaminating apparatus) in the off position.

(2) Operate the M2 water heater for approximately 5 minutes. Then readjust the temperature selector valve control gradually to produce the desired water temperature.

*d. Stopping Procedure.*

(1) When the required amount of water is heated to the desired temperature, the M2 water heater can be stopped by performing the "to deactivate heater" operating instructions (B, fig. 1-5).

(2) Place the heater control switch to PURGE ON position. After combustion ceases, operate the M2 water heater for 2 minutes to purge the equipment.

(3) Continue to cycle water through the low-pressure heating boiler until the water temperature on the water temperature gage is at approximately 100° F. Place the toggle switch that is on the support plate of the M9 decontaminating apparatus in off position. Disconnect the main electric power cable. Install the protective cap over the socket receptacle. Stow the main electric power cable in the storage compartment of the M2 water heater.

(4) Disconnect the fuel supply and fuel return lines of the fuel hose from the M2 water heater. Install the protective caps. Disconnect the fuel hose from the 5-gallon gasoline can. Drain the fuel hose and stow it in the storage compartment. Install a cap on the 5-gallon gasoline can.

(5) Disconnect the water hose at the heater outlet pipe connection on the M9 decontaminating apparatus. Disconnect the water hose at the heater inlet pipe connection on the M9 decontaminating apparatus. Disconnect the water hose at the bottom of the M2 water heater. The water in the low-pressure heating boiler will drain entirely from the unit. Install the protective cap over the inlet water pipe at the base of the M2 water heater skid. Stow the water hose in the storage compartment.

(6) Close and latch the storage compartment cover. Complete equipment logbook entries.

### Section III. OPERATION OF MATERIEL USED IN CONJUNCTION WITH M2 WATER HEATER

#### I-9. M9 Decontaminating Apparatus

In most applications, the M9 decontaminating ap-

paratus will be the source of the water supply required to operate the M2 water heater. The M9 de-

contaminating apparatus will also use the heated water. The M9 decontaminating apparatus consists of a steel-coated tank, centrifugal pump, transmission power takeoff, piping, valves, and hose that is mounted permanently on a modified M45 2½-ton 6 by 6 cargo truck chassis without front winch. TM 3-4230-203-12 and LO 3-4230-203-12 contain detailed information on the M9 decontaminating apparatus.

#### **2-10. M45 Truck Chassis**

The M45 truck chassis provides mobility for the M9 decontaminating apparatus and the M2 water heater. The 2½-ton 6 by 6 truck chassis provides the electrical power to operate the M2 water heater. A source of 24- or 28-vdc is required to operate the M2 water heater. A source of 24-vdc is acquired through a switch and socket receptacle on the M9 decontaminating apparatus. When power is applied to the M2 water heater from this battery source, the truck motor must be operating in order to prevent draining energy from the vehicle battery. TM 9-2320-209-10 and LO 9-2320-209-12 give instructions for operation and maintenance of the modified M45 truck chassis.

#### **2-11. Power Supply Generator**

The 24- or 28-vdc electrical power that is required for the M2 water heater must come from an external source. If the M2 water heater is used to heat water to be used to shower personnel or wash a large number of cargo or combat vehicles (and the M9 decontaminating apparatus is not used), a portable motor-generator set must be used as the power source.

#### **2-12. Fuel Supply and Multifuel Capability**

Fuel to operate the M2 water heater may be supplied from numerous sources (i.e., 5-gallon gasoline can, 55-gallon drum, etc.). The fuels can be of the approved types presented in paragraph 2-5c.

#### **2-13. Water Supply**

An external water supply that is supplied under pressure (or from an external source such as a water pump) is required to operate the M2 water heater, when the M9 decontaminating apparatus is not used.

### **Section IV. OPERATION UNDER UNUSUAL CONDITIONS**

#### **2-14. Operation in Sandy or Dusty Areas**

Locate the M2 water heater in an area free of sand and dust, if possible. If possible, wet down the surrounding area to avoid dust accumulation. Keep the cover panels in place on the M2 water heater and exercise care to keep sand and dust exposure to a minimum. Clean the equipment often and thoroughly.

#### **2-15. Operation in Extreme Heat**

Inspect the rubber hoses once a week for signs of wear and damage. Rubber deteriorates rapidly in extreme heat. Keep the M2 water heater well ventilated. Inspect the electrical wiring and connections frequently, because heat causes rapid deterioration of insulation.

#### **2-16. Operation in Snow and Extreme Cold**

Drain all water from the low-pressure heating boiler and the water hose when the M2 water heater is not in operation. Remove accumulations of snow and ice from the M2 water heater prior

to operation. Do not touch cold metal with bare hands, as the skin sometimes freezes fast to such surfaces and cannot be released without being torn loose or until the metal is heated. When operating the M2 water heater off the M9 decontaminating apparatus, avoid areas that may become swampy after a thaw or a rain. Exercise care to prevent condensation of moisture in the fuel supply. Provide sufficient ventilation to eliminate vapors and carbon-monoxide accumulations around the working vicinity of the M2 water heater.

#### **2-17. Operation in Salt Water or Tropic Areas**

Growth of fungus is a major cause of equipment failure in humid climates. Take every precaution to keep the M2 water heater dry and well ventilated. Paint all chipped or scratched surfaces to prevent rust and corrosion. Keep electrical connections dry and wipe all exposed surfaces frequently.

## CHAPTER 3

### OPERATOR'S MAINTENANCE INSTRUCTIONS

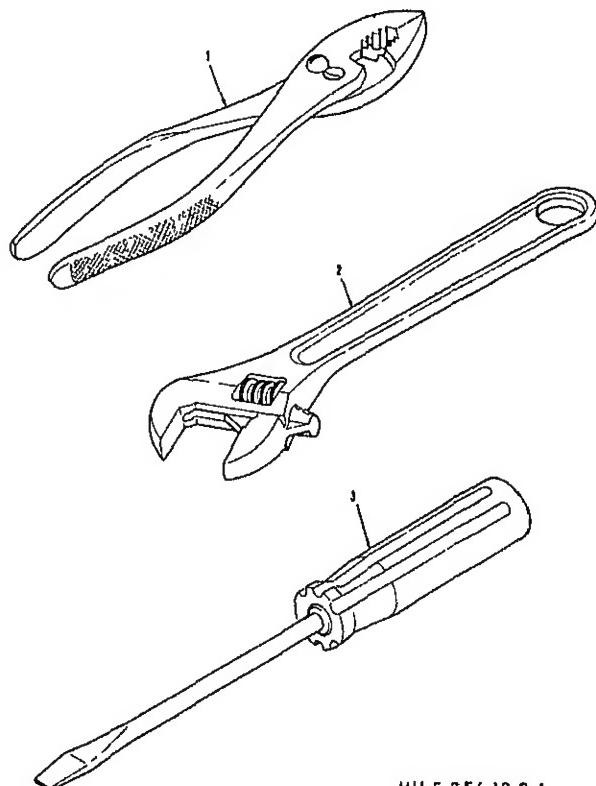
#### Section I. SPECIAL TOOLS AND EQUIPMENT

##### 3-1. Special Tools

Special tools provided with the M2 water heater are a pair of slip joint pliers (1, fig. 3-1), an 8-inch adjustable wrench (2), and a flat tip screwdriver (3). The special tools are stowed in the tool carrier when not in use.

##### 3-2. Equipment

The fuel hose is the only equipment supplied with the M2 water heater. The fuel hose is stowed in the storage compartment when not in use.



MU-E-356-12-3.1

1 Slip joint pliers                  2 Adjustable wrench  
    3 Flat tip screwdriver

Figure 3-1. Special tools.

#### Section II. OPERATOR'S PREVENTIVE MAINTENANCE SERVICES

##### 3-3. General

The operating crew (or decontaminating section personnel) is responsible for regular performance of the preventive maintenance services to insure that the M2 water heater operates properly and to lessen the probability of mechanical failure. These services consist of before-, during-, and after-operation services. Intervals of maintenance are based upon normal operation and shall be reduced or extended depending on the operating conditions.

##### 3-4. Before-Operation Services

a. *Purpose.* The purpose of before-operation services is to determine that the M2 water heater is in good operating condition. Deficiencies must be corrected or reported to organizational maintenance personnel for correction before the equipment is placed in operation.

b. *Visual Inspection.* Make a thorough visual inspection by removing the cover panels of the M2 water heater and inspecting for loose or miss-

Table 3-1. Preventive Maintenance Checks and Services—Continued

Interval and sequence No		Item to be inspected	Procedure	Paragraph reference
Before-operation	During-operation	After-operation		
11		Heater control switch S4 plies.	Make certain that heater control switch S4 is in HEATER ON position.	2-8a
12		Gages	Inspect for correct pressure and temperature indications.	2-8c
13		Fuel lines	Inspect fuel lines for evidence of leaks	2-8b and c
14		Water hoses	Inspect water hoses for leaks at connections. Make certain that gaskets are present and in good condition.	2-8
23		Records	Keep records complete (TM 38-750). Inspect the equipment logbook to see that proper entries have been made. Make certain that the M9 decontaminating apparatus equipment logbook includes entries for the M2 water heater used with it.	3-6a

### Section III. OPERATOR'S TROUBLESHOOTING CHART

#### 3-8. General

This section contains information useful in locating and correcting malfunctions that may develop in the M2 water heater. Each malfunction is followed by a description of probable causes and possible remedies. Remedies are indicated which must be applied by higher categories of maintenance.

#### 3-9. Burner Sputters Out

Probable cause	Possible remedy	Probable cause	Possible remedy
Wrong fuel pressure.	Inspect to see that the fuel-pressure setting is correct for fuel being used.	"frozen" fuel pump.	Tenantee personnel to replace the fuel pump, if necessary. Operate the M2 water heater in PURGE ON position for a minimum of 2 minutes. Inspect to see that the fuel supply system is not leaking. Inspect to see that the fuel pump shaft is not "frozen." If fuel-pump "freezing" has occurred, it is necessary to stop operating. Use the screwdriver to free the shaft of the fuel pump so it will turn by a flick of the finger.
Air in fuel lines.	Operate in PURGE ON position until fuel line is cleared. Inspect to see that fuel is returning to fuel supply container.	Clogged fuel nozzle (burner tip) or atomizing head.	Notify organizational maintenance personnel.
Insufficient power.	Inspect the 24- or 28-vdc power source for loose or broken connections. Inspect for loose plug or receptacle on the combustion air blower motor or a defective combustion air blower motor and fan.	Defective fuel lines.	Notify organizational maintenance personnel.
Broken left or right drive arm on the fuel pump, the combustion magneto, or the fuel and ignition drive motor.	Notify organizational maintenance personnel.	Spark is weak.	Notify organizational maintenance personnel.
Steam or water escapes from the gasket on the refractory box end of the low-pressure heating boller.	Notify organizational maintenance personnel.	5-gallon gasoline can empty.	Refill the gasoline can or the fuel supply container with fuel.
Clogged fuel filter.	Report to organizational maintenance personnel to remove, clean, or replace the fluid pressure filter element.	Defective wiring.	Report to organizational maintenance personnel.
A defective, worn, or Notify direct support main-			

#### 3-10. Water Too Hot

Probable cause	Possible remedy
Safety features of equipment defective.	Notify organizational maintenance personnel.
Water flow too slow.	Increase flow rate of water (TM 3-4230-203-12).
Clogged strainer in shower assembly.	Stop equipment. Clean the screen in the sediment strainer (TM 3-4230-203-12). Inspect for clogged water hoses. Clear the water hoses.

### 3-11. Water Not Hot Enough

<i>Probable cause</i>	<i>Possible remedy</i>	<i>Probable cause</i>	<i>Possible remedy</i>
Water flowing through the low-pressure heating boiler too rapidly.	Reduce flow rate of water	Improper positioning of the temperature selector valve control	Adjust the temperature selector valve control to correct the temperature.
Temperature selector valve defective.	Report to organizational maintenance personnel.	Clogged fuel lines or defective (worn) fuel pump.	Notify organizational maintenance personnel.

## Section IV. COVER PANELS

### 3-12. Description and Function

a. *Description.* The cover panels comprise the cabinet group in the maintenance allocation chart. The cover panels (fig. 3-2) consist of the storage compartment door (11), end panel (12), left side panel (1), right side panel (15), front panel (19), right-side skid panel (16), left-side skid panels (3 and 23), upper end sheet (22), front top plate (5), rear top plate (14), and control box (20) cover plate. The cover panels are painted metal sheets, which are suitably shaped or marked for identification and equipped with turnlock fastener stud assemblies. Heat-reflective pressure-sensitive adhesive tape (18) is applied to the inside surface of the end panel (12). Heat-reflective pressure-sensitive adhesive tape (2) is applied to the inside surface of the left side panel (1) and the right side panel (15). The left and right side panels are louvered.

b. *Function.* The cover panels inclose the internal parts of the M2 water heater. The heat-reflective pressure-sensitive adhesive tape minimizes external surface temperatures of the left and right side and end panels that the crew may come in contact with. The louvers in the side panels facilitate a draft of air for combustion and cooling ventilation.

### 3-13. Maintenance

a. *Inspection.* Inspect the condition of the heat-

reflective pressure-sensitive adhesive tape that is on the inside surface of the end and two side panels. If the tape is excessively blackened or loose, replace the tape as required. Inspect the condition of the turnlock fastener stud assemblies. If the turnlock fastener stud assemblies are broken, missing, or defective, notify organizational maintenance personnel. Inspect for dented or bent panels. Straighten panels as necessary. If surfaces are scratched, or paint is chipped or cracked, repaint surfaces as necessary. If panels are rusted, notify organizational maintenance personnel. Inspect to see that markings, instruction plates, and nameplates are legible, properly affixed, and clean.

b. *Repair.* Repair defective heat-reflective tape by replacing with new tape as required. Touch up chipped, cracked, scratched, or missing paint with one coat of surface treatment finish No. 4.4., 5.1.1, or 21.5 of MIL-STD-171, color rust-inhibiting olive-drab semigloss enamel No. X24087 of FED-STD-595. In combat situations, use is authorized of noninfrared reflecting quick-drying lusterless enamel No. X34087 of FED-STD-595. Notify organizational maintenance personnel to repaint and restore the complete panels having damaged surfaces. The crew is authorized to clean the cover panels as required, to remove and to install any of the cover panels, if required.

## Section V. WATER TEMPERATURE, FUEL, AND WATER PRESSURE GAGES

### 3-14. Description and Function

a. *Description.* The water temperature gage is described in paragraph 2-6a. The water pressure gage is described in paragraph 2-4a. The fuel pressure gage is described in paragraph 2-5a.

b. *Function.* The water temperature gage indicates the temperature of the water in the low-pressure heating boiler. The fuel pressure gage function is given in paragraph 2-5c. The water pressure gage indicates the pressure at which water is being pumped through the low-pressure heating boiler.

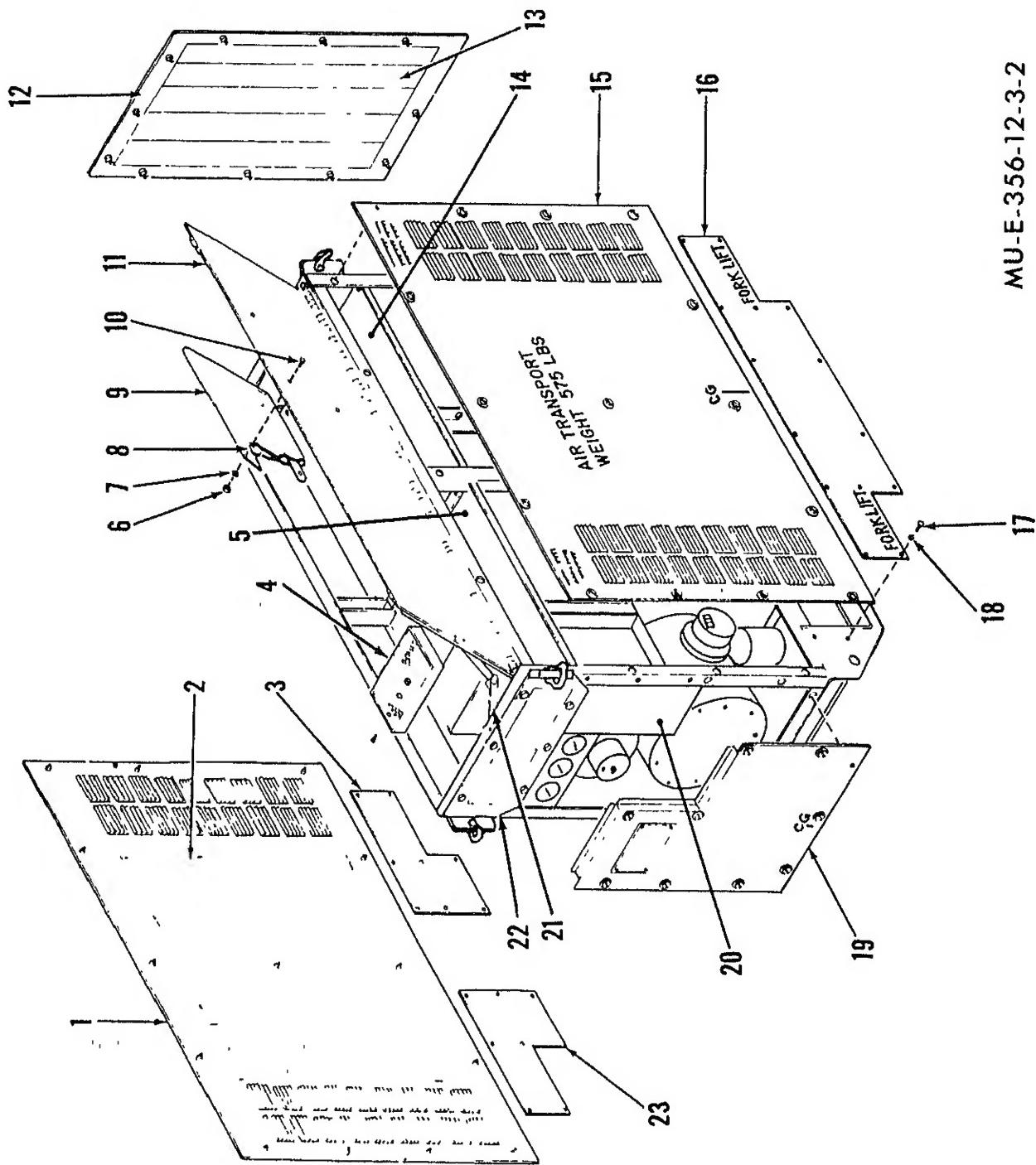
### 3-15. Maintenance

The crew is authorized to inspect the gages for cracked or missing faces, evidence of leaks or loose connections, pointers indicating off scale, and distorted or missing graduated scales. Inspect the water temperature gage for sharp bends or evidence of breaks in the capillary tube. Inspect to see that pointers are not loose and that the water pressure and fuel pressure gage pointers indicate zero with the equipment inert and the absence of pressure.

*Note.* An error the width of the pointer off zero indication is acceptable.

MU-E-356-12-3-2

Figure 8-2. Cover panels (cabinet group).



1	Left side panel	13	Heat-reflective pressure-sensitive adhesive tape
2	Heat-reflective pressure-sensitive adhesive tape	14	Rear top plate
3	Rear left-side skid panel	15	Right side panel
4	Spark arrester	16	Right-side skid panel
5	Front top plate	17	Screw
6	Nut	18	Washer
7	Washer	19	Front panel
8	Strip	20	Control box
9	Tool carrier	21	Door stop assembly
10	Screw	22	Upper end sheet
11	Storage compartment door	23	Front left-side skid panel
12	End panel		

Figure 3-2—Continued.

Inspect to see that the water temperature gage indicates ambient temperature when the equipment is inert. If inspection reveals faulty equip-

ment, notify organizational maintenance personnel.

## Section VI. MAIN ELECTRICAL POWER CABLE

### 3-16. Description and Function

a. *Description.* The main electrical power cable consists of an electrical cable 25 feet long, a cable to connector adapter, a 90-degree plug electrical connector, and two terminal lugs. A stuffing tube is used to prevent the main electrical power cable from being pulled loose from the terminal lug end of the cable that is fastened inside the control box.

b. *Function.* The main electrical power cable is used to provide external 24- to 28-vdc electrical power to the M2 water heater. The cable is stowed in the storage compartment when not in use.

### 3-17. Maintenance

**Warning:** Make sure that the main electrical power cable is disconnected from the electrical power supply before attempting any maintenance.

a. *Inspection.* Inspect the cable for cracks, evidence of scorching or burning from having

crossed over the exhaust stack during use, deterioration, bare or frayed wiring, and unusual wear. Inspect the 90-degree plug electrical connector for being out of round, signs of corrosion, loose or missing hardware, and that it is filled with silicone rubber adhesive and sealant. Inspect to make sure that the insulation as well as the wiring inside are unbroken. If inspection reveals a faulty main electrical power cable, notify organizational maintenance personnel.

b. *Cleaning.* Keep the main electrical power cable as clean as possible at all times. Avoid passing the cable through pools of water during use. Wipe the cable assembly exposed surfaces and the 90-degree plug electrical connector with a dry rag.

c. *Repair.* Repair to the main electrical power cable authorized to the crew is limited to using (if necessary) sandpaper to rub the terminal lugs and the 90-degree plug electrical connector to provide good electrical contact. Use grade 00 to 9/0 sandpaper (not emery paper).

## Section VII. FUEL HOSE ASSEMBLY

### 3-18. Description and Function

a. *Description.* The fuel hose assembly consists of a fuel tank plug, fuel tank line, fuel supply hose, fuel return hose, ground wire, fuel supply quick-disconnect coupling half, and fuel return quick-disconnect coupling half. The fuel supply hose, fuel return hose, and ground wire are each 25 feet long. The fuel tank line attaches to the fuel tank plug and is flexible so that fuel can be drawn from a depth of 36 inches.

b. *Function.* The fuel hose assembly is provided

with the M2 water heater to draw fuel from an external fuel supply. When not in use, the fuel hose is disconnected, drained, and stowed in the storage compartment.

### 3-19. Maintenance

a. *Inspection.* Inspect the fuel hose assembly for cracks, evidence of leaks, signs of deterioration, dry rot, loose or missing clamps, and signs of wear. Inspect to see that the ground wire is welded fast to the flats of the fittings at both

ends. Inspect to see that the electrical insulation tape holds the fuel supply and fuel return hoses and the ground wire together at eight equal spaces starting 6 inches from each end. See that the tape is in satisfactory condition. Inspect to see that end fittings are not out of round and that they operate satisfactorily. If inspection reveals a faulty fuel hose assembly, notify organizational maintenance personnel.

*b. Servicing.* Servicing of the fuel hose assembly consists of replacing the electrical insulation tape as required. Wrap the fuel hose tightly at eight equal spaces starting 6 inches from each end.

*c. Repair.* If repair of the fuel hose assembly beyond replacing electrical insulation tape is required, notify organizational maintenance personnel.

## Section VIII. FUEL AND WATER PRESSURE LINES

### 3-20. Description and Function

*a. Description.* The fuel and water pressure lines are varying lengths of steel tubing and are installed throughout the M2 water heater. Basically, they each consist of flared nuts and steel tubing. The steel tubing is either one-fourth inch or three-eighth inch in diameter.

*b. Function.* The function of the fuel and water pressure lines is to interconnect working parts in the M2 water heater.

### 3-21. Maintenance

Inspect the fuel and water pressure lines for signs of damage or obstructions, dents, and sharp bends. Clean all pressure lines with drycleaning solvent and dry thoroughly. Inspect to see that the pressure lines do not leak. If the fuel and water pressure lines require replacement, notify organizational maintenance personnel.

## Section IX. WATER HOSE ASSEMBLY

### 3-22. Description and Function

*a. Description.* The water hose assembly consists of two pieces of hose, each 13½-feet long, which when coupled together can make a hose assembly 27-feet long. The water hose assembly is made up from a quick-disconnect coupling half, a hose to pipe adapter, two shank nuts, seven clamping bands, two lengths of hose, and a pipe to hose adapter. When the water hose assembly of this M2 water heater is used with the M9 decontaminating apparatus, a female quick-disconnect coupling half must be used. This second quick-disconnect coupling half is with the M9 decontaminating apparatus (TM 3-4230-203-12) and is connected to the cold water inlet pipe at the base of the M2 water heater.

*b. Function.* The water hose assembly is provided with the M2 water heater to transfer water to and from the M2 water heater.

### 3-23. Maintenance

Inspect to see the condition of the gaskets, hose clamps, connectors, and two lengths of hose. Look for cracks, broken or missing parts, evidence of deterioration, damage caused by vehicles passing over the hose, and damage from gasoline, oil, or grease. Inspect the threaded parts for nicks, burrs, and being out of round. Inspect other metal parts for damage that would affect operation and hook up. Notify organizational maintenance personnel if inspection reveals faulty equipment. Keep the water hose external surfaces clean of debris and foreign matter by flushing and washing with hot soapy water. Rinse with fresh water and dry thoroughly. Store the hose when not in use in the storage compartment. (If the M2 water heater is being used with the M9 decontaminating apparatus, one of the two quick-disconnect coupling halves was initially stored with the M9 decontaminating apparatus before it was put in use.)

## Section X. IDENTIFICATION PLATES

### 3-24. Description and Function

*a. Description.* Figure 1-5 shows the identification, instruction, and name plates. They are cemented fast to the equipment.

*b. Function.* These plates provide the crew with pertinent information concerning parts of

the M2 water heater, as well as a brief description of the operating instructions.

### 3-25. Maintenance

The identification, instruction, and nameplates must be inspected to see that they are legible,

properly fastened in place to the equipment, not ripped, printed over, slashed, or torn. If inspection reveals that nameplates are damaged, notify organizational maintenance personnel.

## Section XI. HEAT-REFLECTIVE PRESSURE-SENSITIVE ADHESIVE TAPE AND PAINTING

### 3-26. Description and Function

a. *Description.* Heat-reflective pressure-sensitive adhesive tape (hereinafter referred to as tape) is applied in strips to the inside surface of the end panel, the inside surfaces of the left and right side panels, the outside surface of the control box cover plate, and over the insulation on the back of the control box gage panel. Each strip of tape is 3 inches wide and is aluminized (reflective) on the outer surface.

*Caution:* Do not remove heat-reflective pressure-sensitive adhesive tape.

Touch up paint (one coat) of finish No. 4.4, 5.1.1, or 21.3 of MIL-STD-171, No. X21087 olive-drab (semigloss) of FED-STD-595 is authorized as required.

b. *Function.* The tape is used to reflect heat escaping from the low-pressure heating boiler,

which minimizes external temperatures of cover panels that operating personnel may come in contact with. Paint is applied on the other parts of the cover panels to protect the metal surfaces, preserve appearance, and prevent rust.

### 3-27. Maintenance

The crew is authorized to clean the dirt and soot off of the heat-reflective surface of the tape to preserve the bright and shiny surface. The crew is permitted to use paint to touch up the remaining painted surfaces as required. Exercise care to avoid painting over identification, instruction, and nameplates, rubber grommets, tape, water and fuel hoses, and the main electrical power cable. If maintenance beyond this described is required, notify organizational maintenance personnel.

## CHAPTER 4

### ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

---

#### Section I. SERVICE UPON RECEIPT OF EQUIPMENT

##### **4-1. New Equipment**

*a. General.* The faces of the gages on the control panel are covered with protective paper and cloth tape. The entire M2 water heater is covered with a plastic cover.

*b. Unloading.* The M2 water heater will be received from direct support maintenance personnel as an uncrated skid. Use suitable equipment to lift or tow the skid from the carrier to the organization receiving dock.

*c. Unpacking.* Inspect to see that the equipment is complete by inspecting it against the packing list. Make sure that the special tools, accessories, and TM 3-4410-201-12 are with the equipment. Inspect to see that markings comply with AR 746-5.

*d. Removing Protective Material.* Remove all preservative compounds (if present), side panels, and preservative tape from the equipment. It is necessary to remove the side panels to remove barrier material from the combustion air intake, combustion air blower motor, fuel ignition drive motor, combustion air pressure switch S8, and solenoid valve L1. Where necessary, use any suit-

able solvent to remove residual preservative material.

*Caution:* Do not remove the heat-reflective pressure-sensitive adhesive tape that is applied in strips to the inside surface of the end panel, the inside surfaces of the left and right side panels, the outside surface of the control box cover plate, and over the insulation on the back of the control box gage panel.

*e. Preparation for Operation.* Perform the before-operation services for the M9 decontaminating apparatus (TM 3-4230-203-12) and the before-operation services for the M2 water heater (para 3-4).

##### **4-2. Used Equipment**

Service a used M2 water heater in the same manner as a new one (para 4-1). Examine a used equipment closely for signs of wear, damage, and missing parts. Correct deficiencies or notify direct support maintenance personnel. Make appropriate entries in the equipment logbook (TM 38-750).

#### Section II. PAINTING

##### **4-3. General**

Organizational maintenance personnel are authorized to repaint any cracked, scratched, blistered, or rusted areas of cover panels or components. Clean the marred surfaces until bare metal is exposed by using a wire brush, sandpaper, or suitable cleaning solvent. Do not paint hoses, nameplates, glass faces of gages, heat-reflective tape, electrical contact points, warnings, or other special markings. See TM 9-213 for special painting instructions.

##### **4-4. Paints to be Used**

*a. Primer.* Treat all worn or scratched exterior surfaces with one coat of surface treatment

cleaning method finish No. 4.4, followed by surface treatment finish No. 5.1.1, 5.1.2, or 5.2 of MIL-STD-171.

*b. Final Coat.* Touch up all exterior surfaces with noninfrared reflecting quick-drying paint system 21.5 of MIL-STD-171, color rust-inhibiting olive-drab semigloss enamel No. X24087 of FED-STD-595. In combat situations, use is authorized of noninfrared reflecting quick-drying paint system 20.4, 20.5, or 20.8 of MIL-STD-171, color rust inhibiting olive-drab lusterless enamel No. X34087 of FED-STD-595. Install, restore, or add markings to the M2 water heater as required to comply with AR 746-5.

### Section III. ORGANIZATIONAL PREVENTIVE MAINTENANCE INSTRUCTIONS

#### 4-5. General

The instructions in this section apply to organizational maintenance personnel responsible for maintaining the M2 water heater. The purpose of preventive maintenance services is to detect the first signs of assembly failure in the equipment and to insure that appropriate corrective action is taken before expensive and time-consuming repairs or replacements are required.

a. *Visual Inspection.* Make a thorough visual inspection of the M2 water heater to see that no hardware is loose or missing, that all parts and accessories are present and in good condition. When necessary, tighten or replace hardware. Replace missing parts if authorized (app. C).

b. *Fuel.* When the M2 water heater is to be used, one of the approved fuels (combat automotive gasoline type I (MIL-G-3056B); jet fuel, grade JP-4 (MIL-J-5624F); kerosene (VV-K 211d); or burner fuel oil, grade No. 2 (VV-F-8152)) must be used to fire the low-pressure heating boiler.

*Note.* If combat automotive gasoline is being used, mix 1 pint of No. 2 diesel fuel oil per 5 gallons of gasoline, to prevent "freezing" of the fuel pump.

#### 4-6. Before-Operation Services

Perform all before-operation services described in paragraph 3-4.

#### 4-7. After-Operation Services

Perform all after-operation services described in paragraph 3-6.

#### 4-8. Preventive Maintenance Checks and Services

a. *Purpose.* The preventive maintenance checks and services (table 4-1) provide organizational maintenance personnel with a list of maintenance services which must be performed at the prescribed intervals. Use the list to make sure that all required maintenance is accomplished. If corrective action is not authorized at organizational level, report equipment faults to direct support maintenance personnel.

b. *Explanation of Columns.* A number under the weekly or monthly heading in the "Interval and sequence No." column indicates that the services opposite the number must be performed at the prescribed interval. The number also indicates the sequence in which the service must be performed and is the "TM Item No." referred to on DA Form 2404 (TM 38-750). Weekly services must be performed weekly or after 60 hours of operation, whichever occurs first. Monthly services must be performed monthly or after 240 hours of operation, whichever occurs first.

*Table 4-1. Preventive Maintenance Checks and Services*

Organizational Maintenance Category			Weekly and Monthly Schedule	
Interval and sequence No.		Item to be inspected	Procedure	Paragraph reference
Weekly	Monthly			
1	10	Publications	See that a copy of TM 3-4410-201-12, TM 3-4230-203-12, LO 3-4230-203-12, and the equipment logbook (TM 38-750) are present with an M2 water heater that is being used with an M9 decontaminating apparatus. Make sure that entries in the equipment logbook are current and that the manuals are in good serviceable condition.	3-4b, 3-6b, 4-5, 4-6
2	11	External surfaces	Inspect the general appearance of the M2 water heater. Pay particular attention to cleanliness, and loose, missing or damaged hardware. Look for evidence of leaks. Inspect the condition of painted surfaces.	3-4b, 3-6a, 4-5, 4-6
3	12	Markings and identification	Inspect the M2 water heater, paying particular attention to cleanliness, legibility of nameplates, markings, identification, and condition of painted surfaces.	3-4a, 4-5, 4-6
4	13	Tools and accessories	Inspect to see that the special tools and accessories are in the tool carrier or in the storage compartment, and that they are in good condition.	3-1, 3-2, 4-1c, 4-19, 4-20

*Table 4-1. Preventive Maintenance Checks and Service—Continued*

Interval and sequence No		Item to be inspected	Procedure	Paragraph reference
Weekly	Monthly			
5	14	Water hose assembly	Inspect condition of gaskets, connectors, and threads. Replace gaskets, if required. Inspect the hoses for cracks, splits, or deterioration. Replace if necessary.	3-22, 3-23, 4-25, 4-26
6	15	End and side panels	Inspect the condition of the heat-reflective pressure-sensitive adhesive tape. Clean as required. Replace as needed.	3-12, 3-13, 4-17, 4-18
7	16	Spark arrester	Inspect the condition of the spark arrester in the exhaust stack for possible damage to the screen. If screen is torn or has puncture holes, replace the spark arrester.	4-31, 4-32
	17	M2 water heater detailed inspection.	If M2 water heater has not been used for 6 months, operate the M2 water heater and perform all operator maintenance checks and services.	2-7, 2-8, 3-4, 3-5, 3-6
8	18	Fluid pressure filter and skid assembly.	Inspect condition of fluid pressure and skid assembly. Clean the fuel filter body and cover, if necessary. If inspection reveals a leaking or defective fuel filter, replace filter element.	4-35, 4-36
9	19	Records	Keep records complete (TM 38-750). Inspect the equipment logbook to see that the proper entries have been made.	1-2

## **Section IV. ORGANIZATIONAL TROUBLESHOOTING CHART**

## 1-9. General

This section contains information useful in locating and correcting malfunctions that may develop in the M2 water heater. Each malfunction is followed by a description of probable causes and possible remedies. Remedies are indicated which must be applied by direct support maintenance personnel. Additional troubleshooting information is contained in paragraphs 3-8 through 3-11.

**-10. M2 Water Heater Does Not Heat Water**

<i>Probable cause</i>	<i>Possible remedy</i>
Defective flame switch S2.	Replace the defective flame switch S2 (para 4-32c (1)).
Improper water input connections.	Change interconnecting hose connections on equipment.
Inadequate fuel supply.	Inspect and replenish fuel supply in 5-gallon gasoline can.
Defective wiring or thermostatic (temperature limit) switch S1.	Report to direct support maintenance personnel.
Ignition cable defective.	Report to direct support maintenance personnel.
Defective electrical power source from 24-vdc truck battery.	Inspect electrical cable and connectors. Inspect to see that toggle switch on hood and panel assembly support plate (TM 8-4230-203-12) is on, and that fuse in the power line is good.

#### **4-11. Combustion Air Blower Motor Does Not Operate**

<i>Probable cause</i>	<i>Possible remedy</i>
.Plug connector on combustion air fan motor loose. Defective wiring.	Tighten the plug connection (6, fig. 2-1).
Defective combustion air blower motor B1.	Report to direct support maintenance personnel.
	Report to direct support maintenance personnel.

**4-12. Fuel and Ignition Drive Motor Does Not Operate in PURGE ON Position**

<i>Probable cause</i>	<i>Possible remedy</i>
Plug connector on combustion air fan motor loose.	Tighten the plug connection (6, fig. 2-1).
Defective flame switch S2.	Replace the defective flame switch S2 (para 4-32c (1)).
Defective ignition relay K1.	Report to direct support maintenance personnel.
Defective or "frozen" fuel pump.	Perform procedure in paragraph 3-4c.
Defective heater control switch S4.	Report to direct support maintenance personnel.
Defective wiring or improper electrical connections.	Report to direct support maintenance personnel or inspect heater control switch position.
Defective fuel and ignition drive motor B2.	Report to direct support maintenance personnel.

#### 4-13. Fuel and Ignition Drive Motor Does Not Restart When Heater Control Switch is Positioned to HEATER ON

<i>Probable cause</i>	<i>Possible remedy</i>	<i>Probable cause</i>	<i>Possible remedy</i>
Defective TD-1 2-second or TD-2 120-second time delay relay.	Replace time delay relay TD-1 or TD-2 (para 4-24d(1)).	Ignition cable defective.	beyond authorized repair, report to direct support maintenance personnel.
Loss of combustion air.	Report to direct support maintenance personnel.	Magneto drive arm or driven arm broken.	Report to direct support maintenance personnel.
Defective ignition relay K1.	Report to direct support maintenance personnel.	Defective fuel system.	Replace the broken drive arm (para 4-36d).
Defective combustion air pressure switch S3.	Report to direct support maintenance personnel.	Defective fuel and ignition drive motor.	Report to direct support maintenance personnel.
Defective thermostatic (temperature limit) switch S1.	Report to direct support maintenance personnel.		Report to direct support maintenance personnel.
Defective wiring.	Report to direct support maintenance personnel.		Report to direct support maintenance personnel.

#### 4-14. Desired Fuel Pressure Cannot be Obtained

<i>Probable cause</i>	<i>Possible remedy</i>	<i>Probable cause</i>	<i>Possible remedy</i>
Defective fuel lines.	Inspect and, if the fuel lines leak, notify direct support maintenance personnel.	Excessive water temperature ( $188^{\circ}$ F. - $212^{\circ}$ F. or greater) as a result of defective or an out of adjustment TEMPERATURE SELECTOR valve.	Adjust temperature selector valve. Report to direct support maintenance personnel.
Clogged fluid pressure fuel filter.	Clean or replace clogged fluid pressure filter element (para 4-36b).	Water discharge rate is not high enough.	Increase water demand. Inspect for clogged hoses or debris in lines. Restart the M2 water heater.
Defective fuel pressure gage.	Report to direct support maintenance personnel.	Fluid pressure filter element defective or clogged	Clean or replace the clogged fluid pressure filter element (para 4-36b).
Fuel pump drive arm or driven arm broken.	Replace the broken drive arm (para 4-36d).	Defective flame switch S2, TEMPERATURE SELECTOR valve set improperly.	Replace flame switch (para 4-32e(1)). Rotate clockwise.
Defective fuel pump.	Report to direct support maintenance personnel.	Defective combustor ignition plug.	Adjust or replace combustor ignition plug (para 4-32e(2)).
Low voltage power supply.	Report to direct support maintenance personnel.	Magneto points improperly set or magneto defective.	Perform magneto servicing. Report to direct support maintenance personnel.
Defective TEMPERATURE SELECTOR valve.	Report to direct support maintenance personnel.	Inadequate fuel supply.	Inspect fuel supply. Replenish fuel supply, if required.
Defective fuel and ignition drive motor B2.	Report to direct support maintenance personnel.	Defective fuel lines (clogged or leaking air).	Inspect for dents, block in line, or leak. Notify direct support maintenance personnel.

#### 4-15. Fuel Fails to Ignite

<i>Probable cause</i>	<i>Possible remedy</i>	<i>Probable cause</i>	<i>Possible remedy</i>
TEMPERATURE SELECTOR valve set improperly.	Rotate clockwise.	Fuel atomizing nozzle dirty or defective	Clean fuel atomizing nozzle. If defective, replace the fuel nozzle (para 4-32e(2)).
Defective combustor ignition plug.	Adjust or replace the combustor ignition plug (para 4-32e(2)).	TEMPERATURE SELECTOR valve defective or out of adjustment.	Report to direct support maintenance personnel.
Magneto points improperly set or magneto defective.	Report to direct support maintenance personnel.	Loss of combustion air pressure or defective air pressure switch S3.	Report to direct support maintenance personnel.
Inadequate fuel supply.	Inspect to see if fuel is exhausted. Replenish fuel supply.	Defective thermostatic (temperature limit) switch S1.	Report to direct support maintenance personnel.
Defective fuel lines (clogged or leaking air).	Inspect for dents, block in line, or leak. Report to direct support maintenance personnel.	Defective fuel and ignition system.	Report to direct support maintenance personnel.
Clogged fluid pressure fuel filter.	Clean or replace clogged fluid pressure filter element (para 4-36b).	Defective wiring.	Report to direct support maintenance personnel.
Fuel nozzle holder and fuel nozzle dirty or defective.	Clean fuel nozzle. If defective, replace. If defect is		

#### Section V. SIDE, END, AND FRONT PANELS

##### 4-17. Description and Function

a. *Description.* The left side panel (1, fig. 3-2),

right-side skid panel (16), end panel (12), and front panel (19) are described in paragraph 3-12a.

*b. Function.* The function of the panels is contained in paragraph 3-12b

#### 4-18. Maintenance

*a. Inspection.* Inspect to see that the side, end, and front panels are not bent, and that parts are not rusted, dirty, corroded, or missing. See that markings and plates are legible, in good condition, and properly mounted.

*b. Cleaning.* Clean the panel surfaces with a solution of hot soapy water; then follow with a

rinse of fresh water. Use a suitable cleaning solvent, if necessary, for stubborn stains, grease spots, and other foreign matter. Wipe all surfaces with a clean dry cloth.

*c. Repairs.* Repairs to the panels consist of repainting surfaces that require paint, restoring all markings, straightening bent or deformed panels, or replacing an individual panel as a unit, if required. If turnlock fastener stud assemblies are broken or damaged, notify direct support maintenance personnel to make the necessary repairs.

### Section VI. TOOL CARRIER

#### 4-19. Description and Function

*a. Description.* The tool carrier is made of canvas and is attached to the storage compartment door with screws, washers, nuts, and two metal strips.

*b. Function.* The tool carrier is used to store a copy of TM 3-4410-201-12, one pair of slip joint pliers, one flat tip screwdriver, and one adjustable open end wrench with the M2 water heater at all times.

#### 4-20. Maintenance

*a. Inspection.* Inspect to see that the tool car-

rier is not damaged and that all the hardware is tight. Inspect to see that the canvas material is not ripped, frayed, or oil smeared.

*b. Cleaning.* Clean the tool carrier using methods and materials prescribed in FM 21-15.

*c. Removal.* Remove four nuts, washers, and screws that fasten the two strips to the storage compartment door. Remove the strips and the canvas tool carrier as a unit. Replace as necessary.

*d. Installation.* Install the two strips in the canvas tool carrier. Install the two strips and the canvas tool carrier to the storage compartment door using four screws, washers, and nuts.

### Section VII. CONTROL BOX COVER PLATE

#### 4-21. Description and Function

*a. Description.* The control box cover plate (1, fig. 4-1) consists of a metal plate with seven screw holes, one cutout for a rubber grommet (3), and heat-reflective pressure-sensitive adhesive tape (2). The cover plate is also painted.

*b. Function.* The cover plate is installed on the rear side of the control box to protect the components that are within the control box. The heat-reflective pressure-sensitive adhesive tape is applied to the outside surface of the cover plate to reflect heat from the low-pressure heating boiler. The cutout and rubber grommet are used to pass the capillary tube of the temperature selector valve from inside the control box to the low-pressure heating boiler.

plate (1) to the control box. Remove the cover plate by working the rubber grommet (3) and capillary tube (of the temperature selector valve) clear of the cover plate cutout.

*b. Inspection.* Inspect the condition of the heat-reflective pressure-sensitive adhesive tape, the rubber grommet, and the paint.

*c. Servicing.* Replace the heat-reflective pressure-sensitive adhesive tape as required. Touch up the painted surfaces as required (para 4-4). Be careful not to dull the bright surface of the heat-reflective pressure-sensitive adhesive tape.

*d. Repair.* Replace the rubber grommet, if defective. Replace any missing screws or washers. Straighten bent cover plate as necessary.

*e. Installation.* Insert rubber grommet over the capillary tube. Position the cutout of the cover plate over the capillary tube and work the rubber grommet into place on the cover plate. Aline the screw holes and fasten the cover plate to the control box using seven self-tapping screws and lockwashers. Install the left side panel.

#### 4-22. Maintenance

*a. Removal.* Remove the left side panel (1, fig. 3-2). Remove seven self-tapping screws (4, fig. 4-1) and lockwashers (5) that fasten the cover



- |   |  |   |                    |
|---|--|---|--------------------|
| 1 | Cover plate                                      | 3 | Rubber grommet     |
| 2 | Heat-reflective pressure-sensitive adhesive tape | 4 | Self-tapping screw |
|   |  | 5 | Lockwasher         |

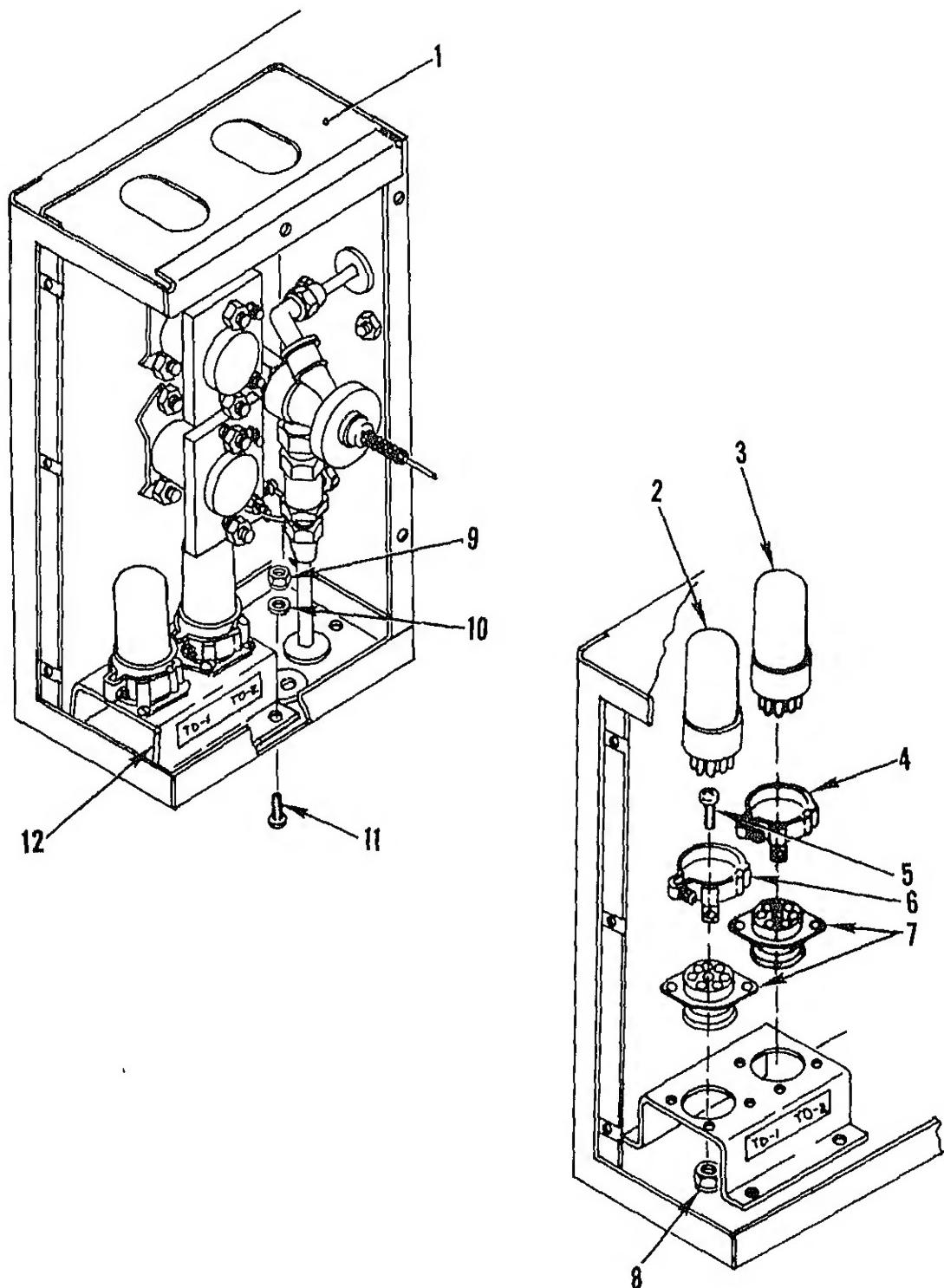
*Figure 4-1. Control box cover plate.*

## **Section VIII. CONTROL BOX ASSEMBLY**

#### **4-23. Description and Function**

*a. Description.* The control box (1, fig. 4-2) assembly is an L-shaped box that houses the controls and instruments and is mounted on the front of the M2 water heater.

*b. Function.* The control box assembly clusters the controls and instruments needed to operate the M2 water heater in one place for one-man operation.



MU-E-356-12-4-2

- |   |                              |
|---|------------------------------|
| 1 Control box   | 6 Tube clamp                 |
| 2 2-second time delay relay (12 No. 2 relay)                | 7 Tube socket                |
| 3 120- ( $\pm$ 35) second time delay relay (12 C 120 relay) | 8 Nut                        |
| 4 Tube clamp  | 9 Nut                        |
| 5 Screw   | 10 Internal tooth lockwasher |
|   | 11 Screw                     |
|   | 12 Relay support             |

Figure 4-2. Time delay relays, removal and installation.

#### 4-24. Maintenance

a. *General.* The 2-second time delay relay (2) TD-1 and the 120- ( $\pm 35$ ) second time delay relay (3) TD-2 are to be maintained by organizational maintenance personnel. These electron tubes are located inside the control box assembly.

b. *Inspection.* Perform a visual inspection of control box components for obvious defects. Inspect to see that electrical wiring has no defects, and that all connections are tight and go to correct terminals. Inspect to see that the fuel line and pressure sensing lines do not leak.

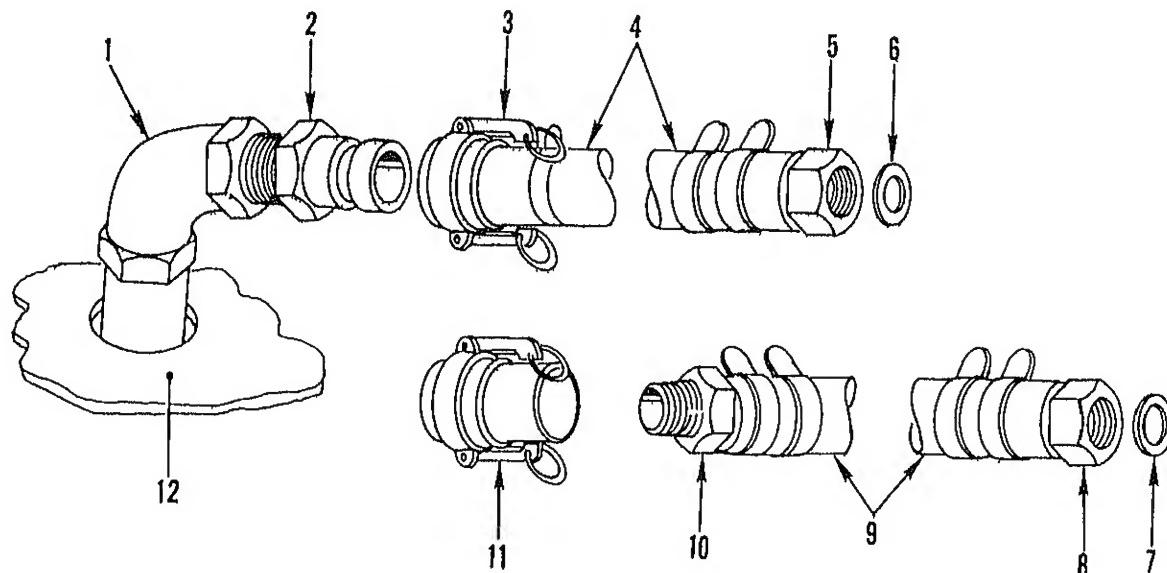
c. *Servicing.* Servicing of the control box components consists of cleaning internal parts, replacing defective heat-reflective tape, touching up scratched surfaces with paint as necessary, and restoring legibility of identification plates.

d. *Repairs.* Repairs are limited to tightening loose fittings on fuel and pressure lines and replacing the time delay relays TD-1 and TD-2 if defective.

(1) *Removal of TD-1 or TD-2 time delay relays.* Remove the control box cover plate (para 4-22a). Loosen the tube clamp (4 or 6, fig. 4-2) that fastens the time delay relay (electron tube) to the relay support (12). Remove the defective relay (electron tube) and replace it if it is faulty.

(2) *Installation of TD-1 or TD-2 time delay relays.* Replace with a new TD-1 (2-second) or TD-2 (120- ( $\pm 35$ ) second) time delay relay (electron tube) at the proper tube socket. With the electron tube plugged into the tube socket, tighten the tube clamp in place. Install the control box cover plate (para 4-22e).

#### Section IX. WATER HOSE ASSEMBLY



MU.E.356-12-4-3

- 1 90° pipe elbow
- 2 Hose straight adapter
- 3 Quick-disconnect coupling half
- 4 13½-foot long water hose
- 5 Stem and shank nut
- 6 Gasket
- 7 Gasket

- 8 Stem and shank nut
- 9 13½-foot long water hose
- 10 Hose straight adapter
- 11 Female quick-disconnect coupling half, FSN 4730-371-9984 (from M9 decontaminating apparatus, TM 3-4230-203-12)
- 12 Storage compartment

Figure 4-3. Water hose assembly.

#### 4-25. Description and Function

a. *Description.* The water hose assembly con-

sists of a quick-disconnect coupling half hose adapter (2, fig. 4-3) that is screwed in the 90°

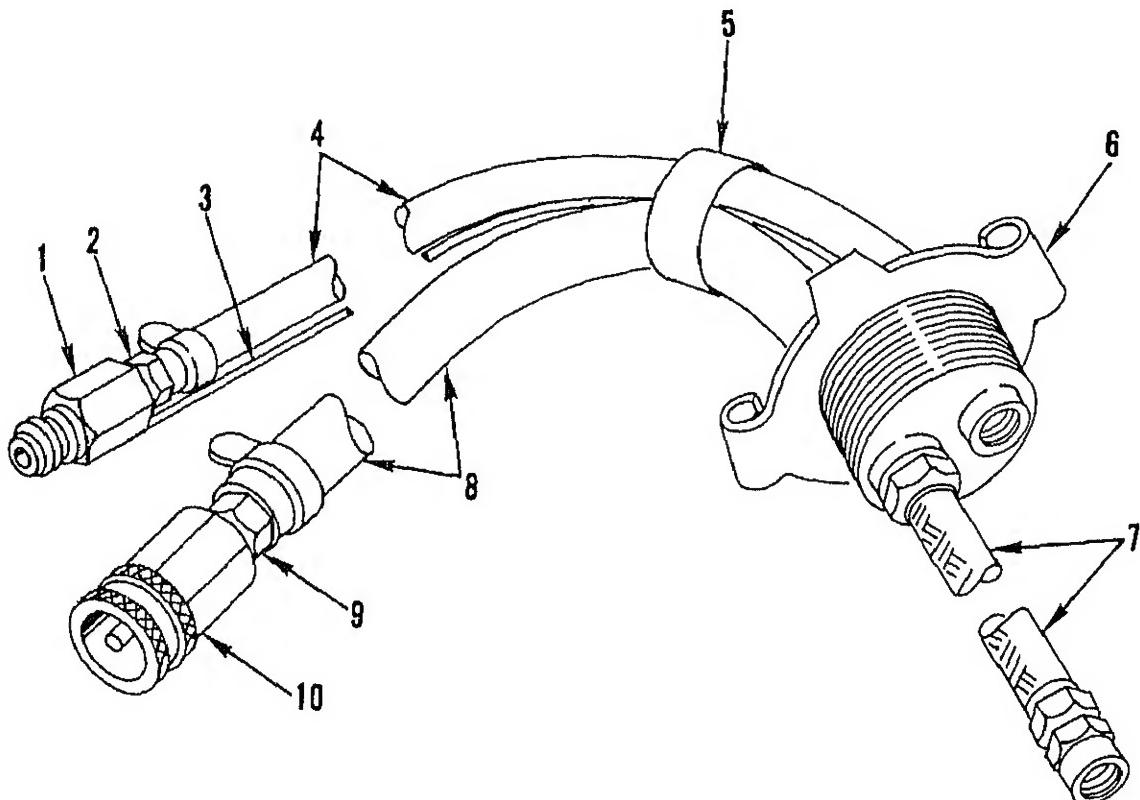
pipe elbow (1) in the storage compartment (12), quick-disconnect coupling half (3), 18 $\frac{1}{2}$ -foot long water hose (4), stem and shank nut (5) end, gasket (6), hose adapter (10), 13 $\frac{1}{2}$ -foot long water hose (9), stem and shank nut (8), and a gasket (7). These two hoses may be screwed together as an assembly.

b. Function. The water hose assembly is provided with the M2 water heater to transfer the water to be heated from the M9 decontaminating apparatus to the M2 water heater and the heated water back to the M9 decontaminating apparatus. Female quick-disconnect coupling half (11) must be screwed on the hose straight adapter (10) to complete the necessary connections to transfer water.

#### 4-26. Maintenance

Inspect the condition of the water hose assembly. Be sure there are no nicks or breaks in the gaskets in the connecting shank nut ends, and that the hose is not cracked, cut, damaged, flattened, or deteriorated. Inspect to see that the hose clamping bands are present and are in good condition. Replace the gaskets as required. Flush the hose with a solution of hot soapy water. Rinse with clear water. Inspect the threaded parts for nicks, burrs, being out of round, or other damage that would affect operation. Repair or notify direct support maintenance personnel to replace the defective parts.

#### Section X. FUEL HOSE ASSEMBLY



MU-E-356-12-4.4

Fuel return quick-disconnect coupling half

Pipe to hose straight adapter  
Ground wire

4 Fuel return hose

5 Electrical insulation tape  
6 Fuel tank plug  
7 Fuel tank line

8 Fuel supply hose

9 Pipe to hose straight adapter  
10 Fuel supply quick-disconnect coupling half

Figure 4-4. Fuel hose assembly.

#### **4-27. Description and Function**

*a. Description.* The fuel hose assembly is a three-hose unit that is joined to a standard size fuel tank plug. The fuel hose consists of the fuel return quick-disconnect coupling half (1, fig. 4-4), pipe to hose straight adapter (2), ground wire (3), fuel return hose (4), electrical insulation tape (5), fuel tank plug (6), fuel tank line (7), fuel supply hose (8), pipe to hose straight adapter (9), and a fuel supply quick-disconnect coupling half (10).

*b. Function.* The fuel hose assembly is provided with the M2 water heater to draw fuel from an external fuel supply.

#### **4-28. Maintenance**

*a. Inspection.* Inspect the fuel hose assembly for condition of the ground wire. Make sure that it is not broken and that it is welded fast to the wrench flats of both ends of the length of hose. Inspect the condition of the fuel supply and the fuel return hoses, the condition of the flexible

fuel tank hose, and make sure that the electrical insulation tape holds the hoses together at eight places. Inspect to see that the threads on the fuel tank plug are not damaged. Inspect to see that the fuel return and the fuel supply quick-disconnect coupling halves are undamaged and are not fouled with foreign matter. If the ground wire welded ends are broken loose, notify direct support maintenance personnel.

*b. Servicing.* Replace electrical insulation tape as required. The fuel supply hose, ground wire, and fuel return hose must be wrapped tightly together at a minimum of eight places starting 6 inches from each end. Remove foreign matter from the open ends of the fuel hose by soaking the ends in a suitable drycleaning solvent and shaking them dry.

*c. Repair.* Organizational maintenance personnel are authorized to remove and replace the fuel tank hose assembly or to replace electrical insulation tape as required.

### **Section XI. MAIN ELECTRICAL POWER CABLE**

#### **4-29. Description and Function**

*a. Description.* The main electrical power cable (fig. 4-5) consists of a two-wire electrical cable that is 25 feet long (3), electrical connector cable clamp (2), 90° angle electrical plug connector (1), and two terminal lugs (8 and 9). The main electrical power cable is stowed in the storage compartment (5) and is attached to the M2 water heater at terminals A2 or relay K1 and the ground lug. A stuffing tube (4) in the storage compartment (5) is used to grip the electrical cable tightly and thereby prevent the electrical cable from being inadvertently pulled loose.

*b. Function.* The main electrical power cable is used to provide external 24- or 28-vdc electrical power to operate the M2 water heater.

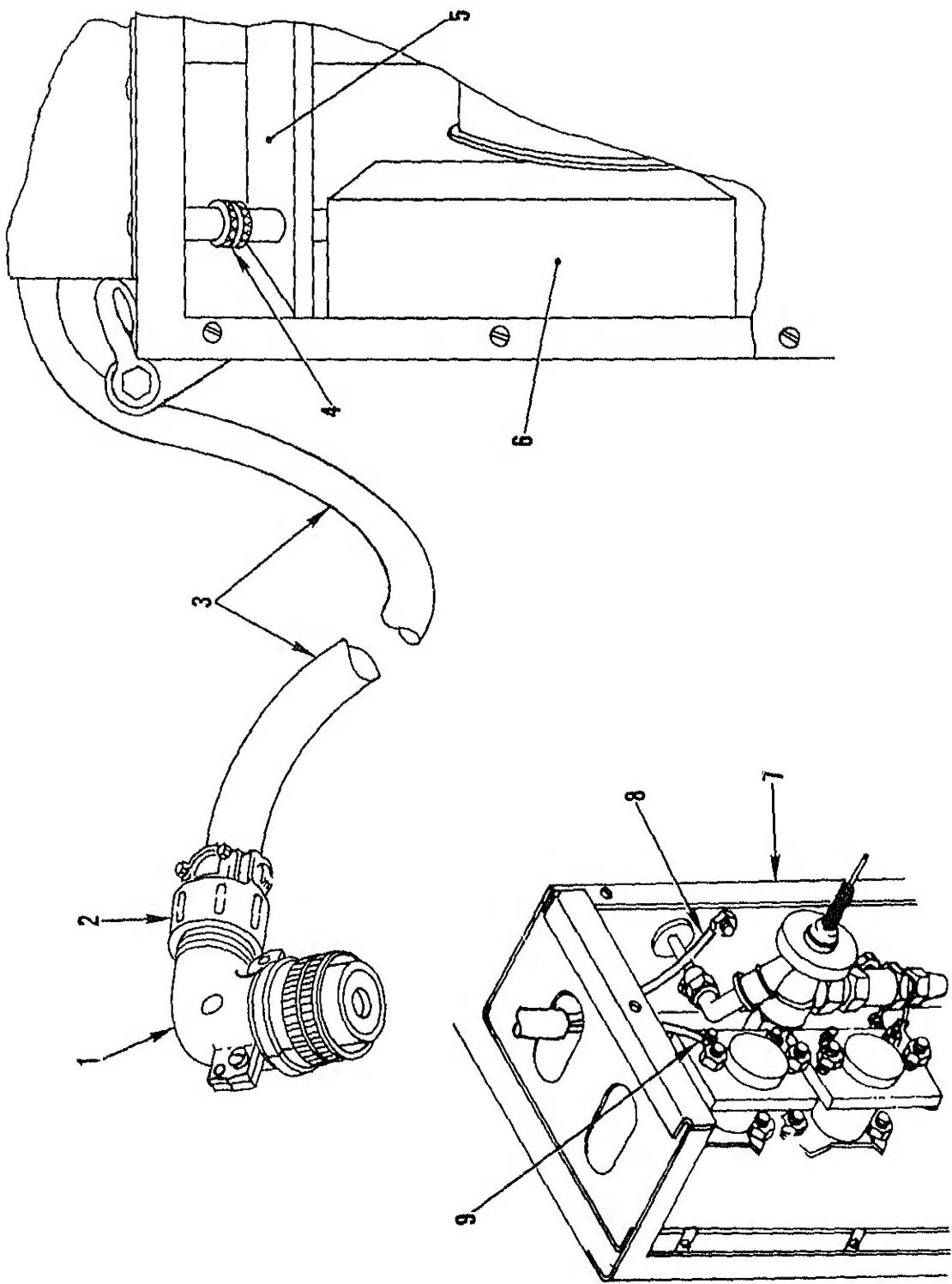
#### **4-30. Maintenance**

Inspect the main electrical power cable for cracks in the length of cable, broken insulation, excessive wear, and connector being out of round. Re-

move the right side panel and the control box cover plate. Inspect the terminal lug (8 and 9) endings of the main electrical power cable. If the detailed inspection of the electrical power cable reveals a faulty cable, the cable is to be removed and replaced as a unit. Disconnect the ground wire terminal lug from the ground lug (8). Disconnect the black (or hot) power wire terminal lug from terminal A2 of ignition relay K1 (Unscrew the stuffing tube (4) from the pipe nipple. Slide the washer up the cable and work the rubber gasket out of the pipe nipple by using the fingers. Carefully pull the main electrical power cable terminal lug end through the adapter in the top front plate. Separate the washer, rubber gasket, and stuffing tube. Notify direct support maintenance personnel to repair the defective cable. Installation of a main electrical power cable is the reverse of the removal procedure used in this paragraph.

MU-E-356-12-4-5

Figure 4-5. Main electrical power cable.



- |   |   |   |  |
|---|---|---|--|
| 1 | 90° angle electrical plug connector     | 6 | Control box (outside surface)                                |
| 2 | Electrical connector cable clamp        | 7 | Control box (cover plate removed)                            |
| 3 | Two-wire electrical cable, 25 feet long | 8 | Ground lug (white-coated wire terminal)                      |
| 4 | Stuffing tube                           | 9 | Power lug (ignition relay K1, black-coated wire terminal A2) |
| 5 | Storage compartment                     |   |  |

Figure 4-5—Continued.

## Section XII. LOW-PRESSURE HEATING BOILER

### 4-31. Description and Function

*a. Description.* The low-pressure heating boiler includes the low-pressure boiler, combustion chamber, combustion air blower motor and fan, flame switch, nozzle holder, ignition plug, spark arrester, exhaust stack, refractory box, pressure relief valve, and ignition cable. The boiler is the largest and heaviest part of the M2 water heater.

*b. Function.* The low-pressure heating boiler is where the actual heat exchange takes place. Part of the burning of the fuel occurs in the combustion tube or bottom half of the boiler. At the rear of the boiler the heat is deflected by the refractory box and returns through tubes with turbulators to effectively exchange the maximum of remaining heat. The exhaust fumes escape from the boiler through the spark arrester and the exhaust stack. The low-pressure heating boiler is used to heat water in large quantities.

### 4-32. Maintenance

*a. Inspection.* Inspect to see that electrical wires are not charred, insulation is not broken, wires are not bare, and that connectors are not loose or missing. Inspect to see that exhaust stack insulation is not broken, loose, or missing. Inspect for evidence of steam or water leakage from the boiler. If any of these things has occurred, notify direct support maintenance personnel.

*b. Servicing.* Servicing of the low-pressure heating boiler consists of cleaning all exposed surfaces, guarding against rust and corrosion, and removing and replacing the combustor cover plate in order to remove and replace the nozzle holder. Then inspect or replace the combustor ignition plug. Clean off the spark arrester in the exhaust stack, and touch up the painted surfaces with paint as required. Use a suitable cleaning solvent for cleaning and dry thoroughly.

#### c. Repairs.

(1) *Flame switch.* Remove five screws and washers that fasten the side exhaust insulation cover to the exhaust insulation cover and cabinet frame. Remove three washers and nuts that fasten the cover to the boiler and remove the cover. Disconnect the electrical wiring from the flame switch. If the electrical wiring to the flame switch or the rubber grommet in the boiler header requires replacement, notify direct support maintenance personnel to make necessary repairs. Use a five-eighth-inch open-end wrench and remove the flame switch from the exhaust stack. Installation of the flame switch is the reverse of the removal procedure.

(2) *Nozzle holder and combustor ignition plug.* Remove the combustor cover plate. Disconnect the two fuel steel tubes from the combustor nozzle holder. Disconnect the ignition cable assembly from the holding bracket. Rotate the combustor nozzle clamp to clear the holding bracket and remove the nozzle clamp and combustion plate as a unit from the combustor assembly. Clean all parts thoroughly in a suitable drycleaning solvent and examine for cracks, breaks, obstructions, damaged threads, and deterioration. Measure the gap between the ignition plug electrode and the electrode on the combustor plate. If the ignition plug is unserviceable, replace with a new ignition plug. The gap should be 5/32-inch. Proper gap may be obtained by bending the electrode on the combustor plate. Inspect the nozzle holder as a unit and replace the oil burner nozzle if defective or unserviceable. Installation of the nozzle holder, ignition plug, ignition cable, and the combustor plate is the reverse of removal.

(3) *Other boiler repairs.* Any repairs of the boiler beyond those described above are not authorized, and direct support maintenance personnel must be notified for correction of deficiencies.

## Section XIII. HEAT-REFLECTIVE PRESSURE-SENSITIVE ADHESIVE TAPE

### 4-33. Description and Function

*a. Description.* Refer to paragraph 3-26a for a description of heat-reflective pressure-sensitive adhesive tape.

*b. Function.* Refer to paragraph 3-26b for the function of heat-reflective pressure-sensitive adhesive tape.

#### 4-34. Maintenance

If the heat-reflective pressure-sensitive adhesive tape (hereinafter referred to as tape) requires replacement, strip the tape from the portion of the equipment involved. (Paragraph 3-26a locates the areas where tape is used.) Use a suitable cleaning solvent to remove residual gummy adhesive left on the panels. Dry the surface thoroughly. Apply new tape to the surface of the panel in strips.

### Section XIV. SKID ASSEMBLY

#### 4-35. Description and Function

a. *Description.* The skid assembly contains the major components of the fuel and ignition system. Forklift openings are provided in the skid for transporting the M2 water heater. The rugged skid contains the fuel and ignition drive motor, the fuel pump, the ignition magneto, the fuel filter, and the solenoid valve. The fuel and ignition drive motor, the ignition magneto, and the fuel pump are interconnected by drive arms.

b. *Function.* The skid assembly is the base of the M2 water heater to which the boiler and the frame are mounted by attaching hardware.

#### 4-36. Maintenance

a. *General.* Organizational maintenance personnel are authorized to service, inspect, and replace the 100 psi fluid pressure filter, inspect or service the fuel pump (to loosen the "frozen" drive arms as necessary). In order to perform authorized maintenance on parts in the skid assembly, remove the skid panels (3, 16, and 23, fig. 3-2) first.

b. *100 psi Fluid Pressure Filter.* The 100 psi fluid pressure filter (fig. 4-6) consists of a cover nut (1), covernut gasket (2), filter cover (4), bowl gasket (5), fluid pressure filter element (6), and filter body (7).

(1) *Inspection.* Inspect the fuel supply line (3) and (8) for evidence of leaks and obvious damage or defects.

(2) *Cleaning.* Clean the fluid pressure filter as a unit by wiping the filter cover and filter body with a suitable drycleaning solvent and drying thoroughly.

(3) *Removal and disassembly.*

**Warning:** When removing the 100 psi fluid pressure filter do not smoke or use an open flame in the vicinity. Take care to avoid spilling fuel. Wipe up all spilled fuel.

**Note.** With the fuel supply line (3) and the fuel pump return line (9) piping arranged as they are now, is the only way that organizational maintenance personnel can replace the 100 psi fluid pressure filter with the tools authorized is to remove the fuel pump return line (9) first.

(a) Remove the fuel pump return line (9). This is to gain access to the covernut (1), so that it can be removed by using the largest tool authorized in the mechanic's tool box.

(b) Remove the covernut (1) and covernut gasket (2) from the filter cover (4).

(c) Pull the filter body (7), fluid pressure filter element (6), and bowl gasket (5) as a unit clear of the filter cover (4) and out of the skid assembly.

(d) Separate the bowl gasket (5) and the fluid pressure filter element (6) from the filter body (7). Discard the covernut gasket (2), the bowl gasket (5), and the fluid pressure filter element (6).

(e) Make sure that the residual bowl gasket (5) material is removed from the seat in the filter cover (4). Doing this prevents possible leaks when the 100 psi fluid pressure filter is assembled.

(f) Clean out any residual or foreign matter inside the filter body (7).

(4) *Assembly and installation.*

(a) Insert a new fluid pressure filter unit (6) in the filter body (7).

(b) Insert a new bowl gasket (5) between the filter cover (4) and the filter body (7). Press these parts in place.

(c) Insert a new covernut gasket (2) over the stud of the filter body (7) that sticks out of the filter cover (4).

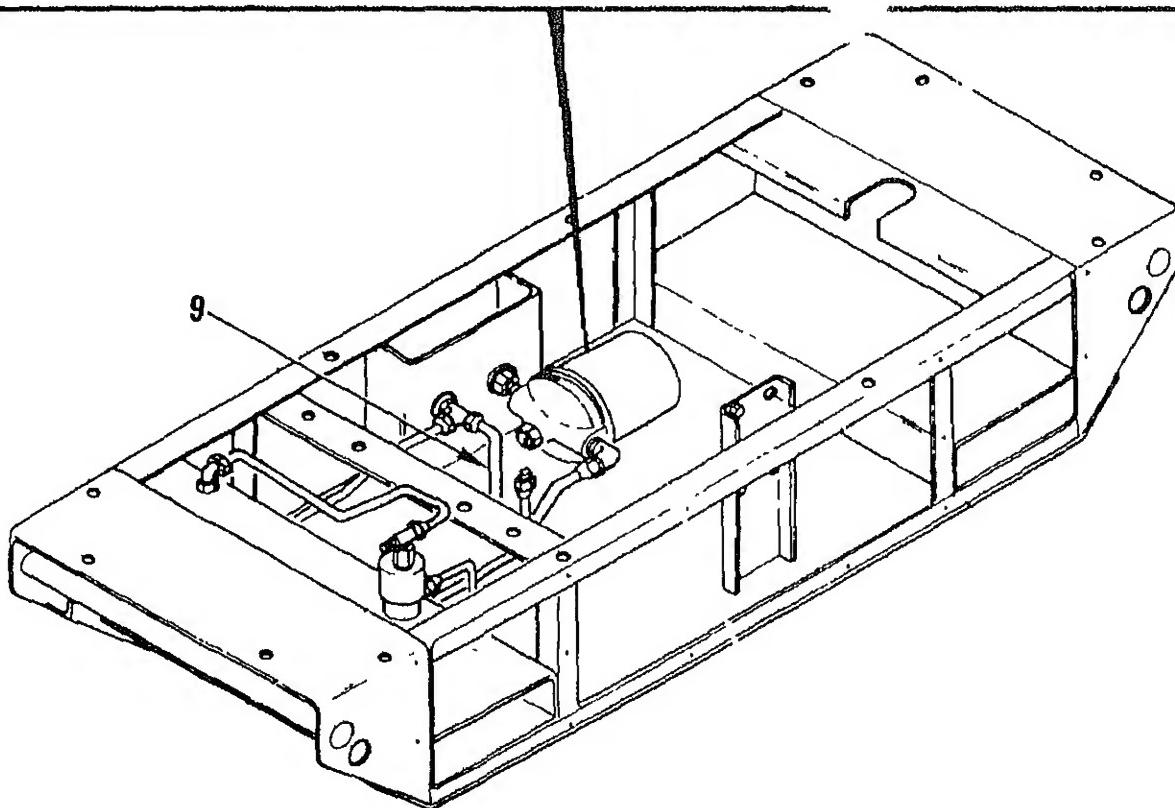
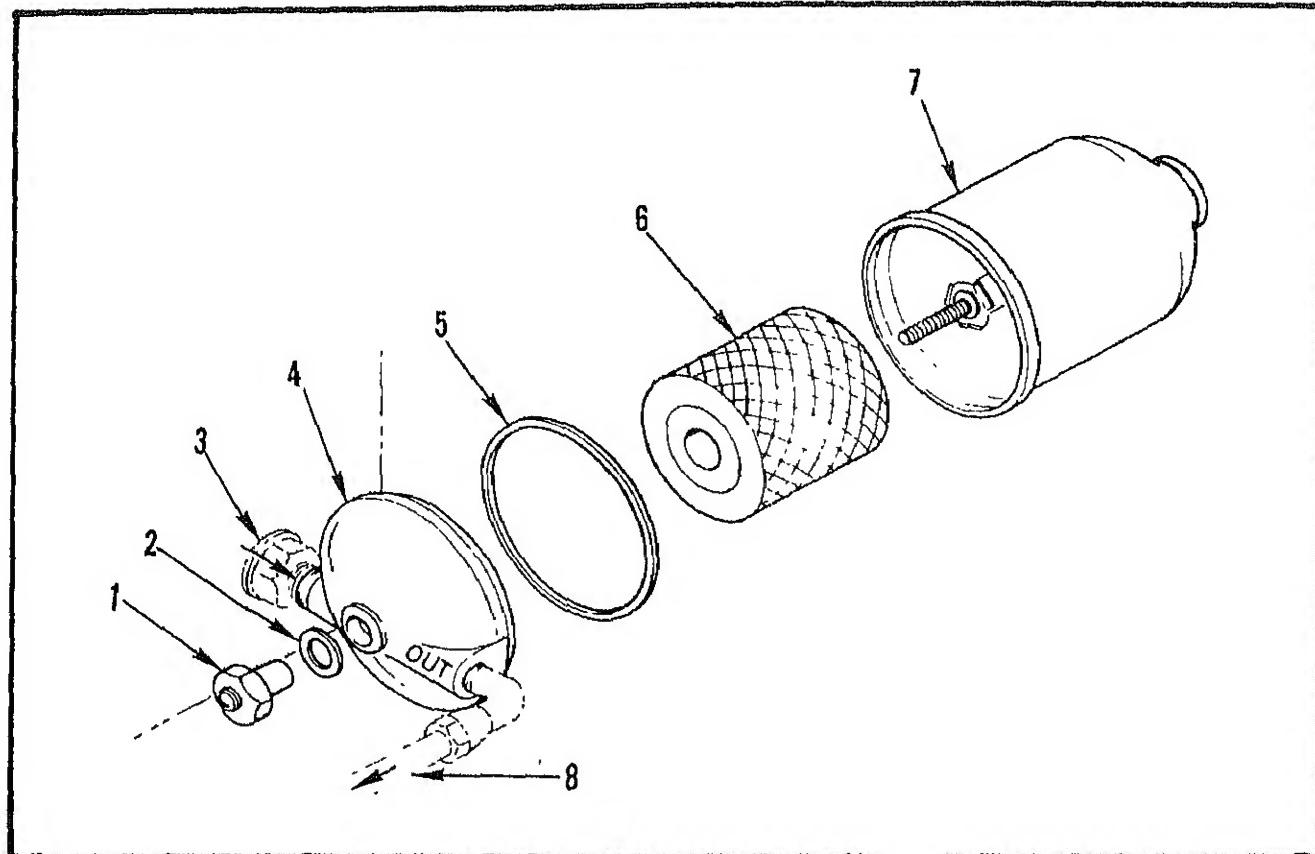
(d) Tighten these parts together using the covernut (1).

(e) Install the fuel pump return line (9).

(f) Install the skid panels (3, 16, and 23, fig. 3-2) when everything is satisfactory.

c. *"Frozen" Drive Arms.* "Freezing" of the fuel pump (as indicated by the drive arms not being able to rotate) occurs when combat automotive gasoline has been used to operate the boiler. If fuel-pump "freezing" has occurred, it is necessary to use a screwdriver across the drive arms and force the drive arms to rotate and free the shaft of the fuel pump. The fuel pump shaft is free when it can be rotated by a flick of the finger. To prevent fuel-pump "freezing" (when combat automotive gasoline is used), add 1 pint of grade No. 2 burner fuel oil (Federal Specification VV-F-815a) per 5 gallons of gasoline into the fuel container.

d. *Drive Arm or Driven Arm.* Organizational maintenance personnel are authorized to replace the fuel and ignition drive motor drive arms, the



MU-E-356-12-4-6

1 Covernut  
 2 Covernut gasket  
 3 Fuel supply line quick-disconnect coupling half

4 Filter cover  
 5 Bowl gasket  
 6 Fluid pressure filter element

7 Filter body  
 8 To-fuel-pump fuel supply line  
 9 Fuel pump return line

Figure 4-6. 100 psi fluid pressure filter.

fuel pump driven arm, and the magneto driven arm.

(1) *Removal.* Remove the spring pin that fastens the faulty drive (or driven) arm to the shaft. (The shaft is either on the fuel pump on

the magneto, or on the fuel and ignition drive motor.) Work the broken arm clear of the shaft and discard the broken arm.

(2) *Installation.* Aline the pinhole in the arm with the pinhole in the flats of the shaft. Fasten the arm to the shaft using the spring pin.

# CHAPTER 5

## SHIPMENT, ADMINISTRATIVE STORAGE, AND DEMOLITION TO PREVENT ENEMY USE

### Section I. SHIPMENT AND ADMINISTRATIVE STORAGE

#### 5-1. Shipment

To prepare the M2 water heater for shipment, pack the pliers, adjustable wrench, screwdriver, and manuals in the tool carrier of the M2 water heater. Close and fasten all panels. Fasten all loose items such as the fuel and water hoses and the main electrical power cable by tying or banding them. Tape the storage compartment door shut with pressure-sensitive adhesive tape. Lift the M2 water heater with a chain hoist, by using the clevises and lifting eyes, or with a forklift, by using the fork channels in the skid assembly. Install the M2 water heater on the right platform of the M9 decontaminating apparatus. Block or

tie the unit in place to prevent shifting. (A universal tiedown kit (FSN 2590-782-1467) with instructions (TB 9-2300-280-30) is available to tie the M2 water heater to the right platform.) If shipment is for a long distance, or if the shipment may be a long time in transit, the using organization may want to package or crate the M2 water heater and ship it separately from the M9 decontaminating apparatus.

#### 5-2. Administrative Storage

Refer to TM 740-90-1 for administrative storage information on this equipment.

### Section II. DEMOLITION TO PREVENT ENEMY USE

#### 5-3. General Destruction Information

If circumstances force abandonment of the M2 water heater in the field, it must be rendered useless or destroyed to prevent its use or study by the enemy. This action will be taken only when, in the judgment of the military commander concerned, it is deemed necessary. Whatever method of destruction is employed, it is essential to destroy the same vital parts of all units and all corresponding repair parts. Be sure to destroy this technical manual and the logbook (TM 38-750).

#### 5-4. Preferred Demolition Methods

Explosives and mechanical means, either alone or in combination, are the most effective methods to employ. Listed below are the vital parts in order of priority of demolition for each preferred method. In each case, completion of the first two steps will render the unit inoperative. Completion of the additional steps listed will further destroy the M2 water heater.

a. *Explosives.* Place one-fourth-pound blocks of TNT in the quantity and locations specified below. For a description of explosives and accessories, their use, and precautions necessary for safe handling, refer to FM 5-25.

(1) *Fuel and ignition drive motor.* Place one one-fourth-pound block of TNT in the drive arm sections at each end of the fuel and ignition drive motor. This will render the magneto, the fuel pump, and the drive motor inoperative.

(2) *Boiler assembly.* Puncture (or remove) the spark arrester and place two one-fourth-pound blocks of TNT in the exhaust stack. This will render the boiler inoperative.

(3) *Combustion chamber.* Place one one-fourth-pound block of TNT in the combustion chamber. This will destroy the combustion chamber.

(4) *Control box.* Remove the cover plate and place one one-fourth-pound block of TNT in the control box. This will destroy all components in the control box.

(5) *Primer, detonating cord, and blasting caps.* Connect the charges for simultaneous detonation with detonating cord. Provide for dual priming to minimize the possibility of a misfire. For priming, use either a nonelectric blasting cap crimped to at least 5 feet of safety fuse or an electric blasting cap and firing wire. Detonate the charges. If primed with nonelectric blasting cap and safety fuse, ignite and take cover. If primed

with the electric blasting cap, take cover before firing the charges. The danger zone is approximately 200 meters.

*b. Incendiary Grenades.* Place and fasten incendiary grenades to the equipment at locations listed in *a(1)* through *(4)* above. Attach a wire or rope lanyard to the pull ring of the grenades. Trail the lanyard along the ground for a safe distance. Straighten the safety pin on each grenade and fire the grenades by pulling the lanyard.

*c. Mechanical Means.* Using a sledgehammer, crowbar, pick, axe, or any heavy tools that may be available, destroy the equipment in the order listed below:

(1) Fuel and ignition drive motor.

(2) Magneto.

(3) Fuel pump.

(4) Control box (gages and other components).

(5) Combustion air blower motor and fan assembly.

(6) Combustion shroud (and attached components).

(7) Puncture boiler.

## 5-5. Other Demolition Methods

When necessary the following methods may be used to destroy or render the M2 water heater inoperable.

*a. Weapons Fire.* Direct small-arms fire at the control box and at the ends of the boiler. It is necessary to pierce the boiler to render it useless. Use artillery, machine guns, rifles employing grenades, or launchers employing antitank rockets.

Several hits are usually required for complete destruction unless an intense fire is started. Oil-soaked rags stuffed in and around the vital parts increase the fire's intensity to insure total destruction.

*b. Submersion.* Totally submerge the M2 water heater in a body of water to provide water damage and some measure of concealment. Pierce the boiler so that it will fill and sink quickly. Salt water will do the greatest damage to metal parts.

*c. Scattering and Concealment.* Remove all easily accessible parts such as hoses, wiring, piping, and relays and scatter them through dense foliage, bury them in sand or dirt, throw them in a lake, stream, or other body of water.

*d. Burning.* Pack rags, clothing, or canvas under the boiler, around the combustor assembly, and in other spaces of the M2 water heater. Saturate this packed material with oil or diesel fuel and ignite with incendiary grenades (TM 9-1370-200). Fasten the grenades to a point where the explosive charge (if used) would be placed. Attach a wire or rope lanyard to each grenade and stretch the wire or lanyard along the ground for a safe distance away from the explosive charge. Straighten the safety pin on each grenade and fire each grenade by pulling on the lanyards.

*e. Misuse.* Pump or dump large foreign particles in the M2 water heater. Fill the exhaust stack with mud or fine dirt. Operate (or fire) the boiler without any water in the boiler until equipment failure occurs.

## APPENDIX A

### REFERENCES

---

AR 740-12	Covered and Open Storage of Supplies
AR 746-5	Color and Marking of Army Materiel
FM 5-25	Explosives and Demolitions
FM 21-15	Care and Use of Individual Clothing and Equipment
TM 3-4230-203-12	Organizational Maintenance Manual: Decontaminating Apparatus, Power Driven, Truck Mounted, 400-Gallon, M9
TM 3-4230-209-12	Operator and Organizational Maintenance Manual: Decontaminating Apparatus, Power-Driven, Skid-Mounted, Multipurpose, Nonintegral, 500-Gallon, M12A1
TM 3-4240-202-15	Organizational, DS, GS, and Depot Maintenance Manual: Mask, Protective, Field, ABC-M17
TM 9-213	Painting Instructions for Field Use
TM 9-1370-200	Military Pyrotechnics
TM 9-2320-209-10	Operator's Manual for 2 1/2-Ton, 6x6, Chassis, Truck: M44, M44A1, M44A2, M45, M45A1, M45A2, M45C, M46, M46A1, M46C, M57, M58, M58A1, etc.
TM 10-8415-204-13	Organizational and DS Maintenance Manual: Rocket Fuel Handlers' Clothing, Toxicological Agents Protective Clothing, Vesicant Gas Protective Clothing, Explosive Handlers' Clothing
TM 38-750	Army Equipment Record Procedures
TM 740-90-1	Administrative Storage of Equipment
TB 9-2300-280-30	Trailer, Cargo: 1/4-Ton, 2-Wheel, M100; Trailer, Cargo: 3/4-Ton, 2-Wheel, M101 and M101A1; Trailer, Cargo: 1 1/2-Ton, 2-Wheel, M104, M104A1, M105A1, M105A2; Truck, Cargo: 3/4-Ton, 4x4, M37, M37B1; Truck, Cargo: 2 1/2-Ton, 6x6, M34, M34C, M35, M35A1, M35A2, M35C, M35D, M36, M36A1, M36A1C, M36A2, M36C, M135, and M211; Installation of Universal Tie Down Anchors
LO 3-4230-203-12	Lubrication Order for Decontaminating Apparatus, Power-Driven, Truck Mounted, 400-Gallon, M9
LO 9-2320-209-12	Lubrication Order for Truck, 2 1/2-Ton, 6x6, Cargo M34, M35, M35A1, M35A2, M36, M36A2, M36C; Chassis M44, M44A1, M44A2, M45, M45A1, M45A2, M45C, M46, M46A1, M46C, M57, M58, M58A1, etc.

## APPENDIX B

### BASIC ISSUE ITEMS

#### Section I. INTRODUCTION

##### **B-1. Scope**

This appendix lists items which accompany the M2 water heater or are required for installation, operation, or operator's maintenance.

##### **B-2. General**

This basic issue items list is divided into the following sections:

*a. Basic Issue Items List Section II.* A list of items which accompany the M2 water heater or are required for the installation, operation, or operator's maintenance.

*b. Maintenance and Operating Supplies Section III.* A listing of maintenance and operating supplies required for initial operation.

##### **B-3. Explanation of Columns**

The following provides an explanation of columns in the tabular list of basic issue items, section II.

*a. Source, Maintenance, and Recoverability Code (SMR), Column 1.*

(1) Source code indicates the selection status and source for the listed item. Source codes are:

<i>Code</i>	<i>Explanation</i>
P .....	Repair parts which are stocked in or supplied from the GSA/DSA, or Army supply system, and authorized for use at indicated maintenance categories.
M .....	Repair parts which are not procured or stocked but are to be manufactured at indicated maintenance categories.
A .....	Assemblies which are not procured or stocked as such but are made up of two or more units, each of which carries individual stock numbers and descriptions and are procured and stocked and can be assembled by units at indicated maintenance categories.
X .....	Parts and assemblies which are not procured or stocked; the mortality of which normally is below that of the applicable end item; and the failure of which would result in retirement of the end item from the supply system.

<i>Code</i>	<i>Explanation</i>
X1 .....	Repair parts which are not procured or stocked, the requirements for which will be supplied by use of next higher assembly or component.
X2 .....	Repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.
C .....	Repair parts authorized for local procurement. If not obtainable from local procurement, such repair parts will be requisitioned through normal supply channels with a supporting statement of nonavailability from local procurement.
G .....	Major assemblies that are procured with PEMA funds for initial issue only to be used as exchange assemblies at DSU and GSU level. These assemblies will not be stocked above DSU and GSU level or returned to depot supply level.

(2) Maintenance code indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is—

<i>Code</i>	<i>Explanation</i>
C .....	Operator/crew

(3) Recoverability code indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable. Recoverability codes are—

<i>Code</i>	<i>Explanation</i>
R .....	Applied to repair parts and assemblies which are economically repairable at DSU and GSU activities and normally are furnished by supply on an exchange basis.
T .....	High dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance activities.

<i>Code</i>	<i>Explanation</i>
U	Repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, high dollar value reusable casings or castings
S	Repair parts and assemblies which are economically repairable at DSU and GSU activities and normally are furnished on an exchange basis. When determined to be uneconomically repairable by DSU and GSU activities, they will be returned to the depot for evaluation and analysis prior to final disposition.

*b. Federal Stock Number, Column 2.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description, Column 3.* This column indicates the Federal item name and any additional description required. A five-digit part number or other reference number is followed by the applicable Federal supply code for manufacturers in parentheses. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

*d. Unit of Measure (U/M), Column 4.* A two character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

*e. Quantity Incorporated in Unit, Column 5.* This column indicates the actual quantity of the item used in the assembly group. A "V" appearing in this column in lieu of a quantity indicates that a definite quantity cannot be indicated.

*f. Quantity Furnished With Equipment, Column 6.* This column indicates the quantity of an item furnished with the equipment.

*g. Illustration, Column 7.* This column is divided as follows:

(1) *Figure number, column 7a.* Indicates the figure number of the illustration in which the item is shown.

(2) *Item number, column 7b.* Indicates the callout number used to reference the item in the illustration.

#### B-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies, Section III

*a. Component Application, Column 1.* This column identifies the component application of each maintenance or operating supply item.

*b. Federal Stock Number, Column 2.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

*c. Description, Column 3.* This column indicates the item name and brief description.

*d. Quantity Required for Initial Operation, Column 4.* This column indicates the quantity of each maintenance or operating supply item required for initial operation of the equipment.

*e. Quantity Required for 8 Hours Operation, Column 5.* This column indicates the estimated quantities required for an average 8 hours of operation.

*f. Notes, Column 6.* This column indicates informative notes keyed to data appearing in a preceding column.

#### B-5. Special Information

Not applicable.

#### B-6. Abbreviations

<i>Abbreviations</i>	<i>Explanation</i>
w -----	wide
w/ -----	with

### Section II. BASIC ISSUE ITEMS LIST

(1) SMR code	(2) Federal stock number	(3) Description  Reference Number & Mfr. Code	(4) Unit of meas	(5) Qty inc in unit	(6) Qty furn with equip	(7) Illustration	
						(a) Figure No.	(b) Itg N <sub>e</sub>
P-C-	5120-223-7396	GROUP 800—TOOLS PLIERS, SLIP JOINT straight nose, combination, w/cutter, 6 in. nom size.	ea		1	1-1	1
P-C-	5120-278-1283	SCREWDRIVER, FLAT TIP w/wrench, grip plastic handle, flared tip, 5/16 in. w, 6 in. lg, black.	ea		1	1-1	3
P-C-	5120-423-6728	WRENCH, OPEN END, ADJUSTABLE 8 in. lg.	ea		1	1-1	2
		GROUP 900—PUBLICATIONS ARMY TECHNICAL MANUAL, TM 3-4410-201-12 .....	ea		1		

### Section III. MAINTENANCE AND OPERATING SUPPLIES

(1) Component application	(2) Federal stock number	(3) Description	(4) Qty required for initial operation	(5) Qty required for 8 hours operation	(6) Notes
FUEL TANK	9130-264-6218	GASOLINE bulk as follows. regular grade  <i>ALTERNATES</i> 9140-286-5291 FUEL OIL, DIESEL grade 2, regular. 9110-242-6748 KEROSENE. 9130-256-8613 TURBINE, FUEL AVIATION grade JP-4.	5 gl	40 gl	

## APPENDIX C

### MAINTENANCE ALLOCATION

#### Section I. INTRODUCTION

##### **C-1. General**

The maintenance allocation chart (sec. II) lists the authorized maintenance functions assigned the maintenance categories for maintenance support of the M2 water heater. This chart is to be used by all levels of maintenance to insure complete support of the equipment.

##### **C-2. Maintenance Functions**

Maintenance functions authorized are limited to and defined as follows:

*a. Inspect.* To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

*b. Test.* To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

*c. Service.* To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air.

*d. Adjust.* To rectify to the extent necessary to bring into proper operating range.

*e. Align.* To adjust specified variable elements of an item to bring to optimum performance.

*f. Calibrate.* To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument compared with certified standard.

*g. Install.* To set up for use in an operational environment such as an emplacement, site, or vehicle.

*h. Replace.* To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

*i. Repair.* To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

*j. Overhaul.* To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect

and Repair Only As Necessary (IROAN) technique.

*k. Rebuild.* To restore an item to a standard as nearly as possible to the original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

*l. Symbols.* Single letter symbol placed in a maintenance function column designates the level of maintenance responsible for performing that particular function.

##### **C-3. Explanation of Format**

The purpose and use of the format are as follows:

*a. Column (1), Group/Index Number.* Column 1 lists the number that is assigned to each group, component, assembly, or subassembly to facilitate references. The numbers are identical to, and in the same sequence as, those assigned to the same group, component, assembly, or subassembly in the repair parts and tools lists.

*b. Column (2), Functional Group.* Column (2) lists the groups, sections, noun names of components, assemblies, subassemblies, and modules on which maintenance is authorized.

*c. Column (3), Maintenance Function.* Column (3) lists the maintenance categories, designated by single letter entered under the maintenance function subcolumn heading, authorized to perform the indicated function.

*d. Use of Symbols.* Single letters (symbols) used in Column (3) are as follows:

Maintenance function codes:

C—Driver, operator, or crew maintenance

O—Organizational maintenance

F—Direct support maintenance

H—General support maintenance

D—Depot maintenance

*e. Column (4), Tools and Equipment.* Column

(4) lists the special tools and test equipment, if required, used in performing the authorized maintenance function.

*i. Column (5), Remarks.* Column (5) explains

and identifies the specific operation to be performed in brief language, such as clean, lubricate, straighten, weld, etc.

## Section II. MAINTENANCE ALLOCATION CHART

(1) Group index number	(2) Functional group	(3) Maintenance function										(4) Tools and equipment	(5) Remarks	
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
100	M2 Liquid Fuel Water Heater	C	C	C	H	-	-	-	O	F	D	-	-	-
	Storage Compartment Door	C	-	-	-	-	-	-	O	F	-	-	-	-
	End, front and side panels	C	-	-	-	-	-	-	O	F	-	-	-	-
	Skid panel,	C	-	-	-	-	-	-	O	F	-	-	-	-
	Control box cover plate	C	-	-	-	-	-	-	O	F	-	-	-	-
	Top plates	C	-	-	-	-	-	-	H	-	-	-	-	-
	Upper end sheet	C	-	-	-	-	-	-	O	-	-	-	-	-
200	Control Box Assembly	C	-	-	H	-	-	-	O	F	-	-	-	-
	Fuel pressure line	C	-	-	-	-	-	-	O	F	-	-	-	-
300	Fuel Pressure Gage	C	-	-	-	-	-	-	F	-	-	-	-	-
	Water pressure gage	C	-	-	-	-	-	-	F	-	-	-	-	-
	Thermometer	C	-	-	-	-	-	-	F	-	-	-	-	-
	Selector valve line	O	-	-	-	-	-	-	F	F	-	-	-	-
	Magneto assembly	O	-	F	F	-	-	-	F	F	-	-	-	-
	Fuel and ignition drive motor	O	-	F	-	-	-	-	F	F	D	-	-	-
	Fuel return line	C	-	-	-	-	-	-	F	F	-	-	-	-
	Fuel supply line	C	-	-	-	-	-	-	F	F	-	-	-	-
	Fuel pump assembly	O	-	F	-	-	-	-	F	F	-	-	-	-
601	Fuel Filter	O	F	-	-	-	-	-	F	O	-	-	-	-
700	Low Pressure Boiler Assembly	C	H	F	-	-	-	-	O	D	-	-	-	-
700	Water Pressure Line	O	-	-	-	-	-	-	F	-	-	-	-	-
701	Combuster Return Line	O	-	-	-	-	-	-	F	-	-	-	-	-
	Nozzle valve line	O	-	-	-	-	-	-	F	F	-	-	-	-
	Combustion air pressure switch	F	F	-	-	-	-	-	F	-	-	-	-	-
	Safety relief valve	F	H	-	F	-	-	-	F	-	-	-	-	-
702	Spark Arrestor	C	O	-	-	-	-	-	O	-	-	-	-	-
	Firebrick box	D	D	-	-	-	-	-	D	-	-	-	-	-
	Flame switch	O	-	-	-	-	-	-	F	-	-	-	-	-
703	Combustion Air Motor Mounting Assembly	O	-	-	-	-	-	-	F	-	-	-	-	-
704	Nozzle Holder Assembly and Ignition Plug	O	-	F	-	-	-	-	F	-	-	-	-	-
	Fuel nozzle	O	-	O	-	-	-	-	O	F	-	-	-	-
705	Water Hose Assembly	C	-	O	-	-	-	-	O	O	-	-	-	-
	Tube socket and clamp support assembly	F	-	-	-	-	-	-	F	-	-	-	-	-
	Heater control switch	F	F	-	-	-	-	-	F	-	-	-	-	-
	Temperature selector valve	F	-	-	F	-	-	-	F	-	-	-	-	-
	Selector return line	C	-	-	-	-	-	-	F	F	-	-	-	-
400	Main Power Cable	O	-	-	-	-	-	-	O	F	-	-	-	-
	Thermostatic switch	O	-	-	-	-	-	-	F	-	-	-	-	-
	Water heater wiring	F	-	-	-	-	-	-	F	F	-	-	-	-
500	Fuel Hose Assembly	C	-	-	-	-	-	-	O	-	-	-	-	-
600	Skid Assembly	O	-	-	-	-	-	-	O	-	-	-	-	-
	Gage port line	C	-	-	-	-	-	-	O	-	-	-	-	-
	Nozzle pressure line	C	-	-	-	-	-	-	F	F	-	-	-	-
	Pump return line	C	-	-	-	-	-	-	F	F	-	-	-	-
	Purge and bypass return line	C	-	-	-	-	-	-	F	F	-	-	-	-

## INDEX

Paragraph	Page	Paragraph	Page		
Accessories . . . . .	1-4e, 3-6b	7, 16	Used . . . . .	4-2	24
Administrative storage . . . . .	5-2	39	Extreme heat, operation . . . . .	2-15	14
After-operation services . . . . .	3-6, 4-7	16, 25	Fail-safe controls . . . . .	1-4d	5
Allocation of maintenance . . . . .	1-3	2	Filter, fuel, fluid pressure . . . . .	4-36b	36
<b>Before-operation services:</b>			Flame switch . . . . .	4-32c(1)	35
Operator or crew . . . . .	2-8a, 3-4	12, 15	Fuel and ignition drive motor		
Organizational maintenance			assembly . . . . .	1-4b	2
personnel . . . . .	4-6	25	Fuel and ignition drive motor does		
Boiler, heating, low-pressure . . . . .	4-31, 4-32	35	not operate in PURGE ON		
Box, control . . . . .	4-23, 4-24	29, 31	position . . . . .	4-12	26
Burner sputters out . . . . .	3-9	18	Fuel and ignition drive motor does		
Cable, power, electrical, main . . . . .	3-16, 3-17,	21	not restart when heater control		
	4-29, 4-30	33	switch is positioned to HEAT-		
Capacities . . . . .	1-6b	7	ER ON . . . . .	4-13	27
Carrier, tool and manual . . . . .	4-19, 4-20	28	Fuel and ignition system . . . . .	1-4b	2
Cold areas, operation in . . . . .	2-16	14	Fuel and water pressure lines . . . . .	3-20, 3-21	22
Combustion air blower motor as- sembly . . . . .	1-4c	3	Fuel fails to ignite . . . . .	4-15	27
Combustion air blower motor does not operate . . . . .	4-11	26	Fuel filter . . . . .	4-36b	36
Combustion system . . . . .	1-4c	3	Fuel hose . . . . .	3-18, 3-19	21,
Component information . . . . .	1-4c	7	4-27, 4-28	33	
Control box . . . . .	4-23, 4-24	29, 31	Fuel pressure gage . . . . .	2-5, 3-14,	10, 19
Control box cover plate . . . . .	4-21, 4-22	28	3-15		
Control system . . . . .	1-4d	5	Description . . . . .	2-5a	10
Controls and instruments, general . . . . .	2-1	10	Location . . . . .	2-5b	12
Cover panels . . . . .	3-12, 3-13,	19	Purpose . . . . .	2-5c	12
	4-17, 4-18	27, 28	Fuel pump . . . . .	1-4b, 4-36	2, 36
Description . . . . .	3-12a	19	Fuel supply, external . . . . .	1-6d, 2-12,	7, 14,
Function . . . . .	3-12b	19	4-5b	25	
Maintenance . . . . .	3-13, 4-18	19, 28	Gage, fuel pressure . . . . .	2-5, 3-14	10, 19
Cover plate, control box . . . . .	4-21, 4-22	28	Description . . . . .	2-5a	10
Data, tabulated . . . . .	1-6	7	Location . . . . .	2-5b	12
Decontaminating apparatus, M9 . . . . .	2-9	13	Maintenance . . . . .	3-15	10
Demolition . . . . .	5-3, 5-4,	39, 40	Purpose . . . . .	2-5c	12
	5-5		Gage, water pressure . . . . .	2-4, 3-14	10, 19
Description, general . . . . .	1-4a	2	Description . . . . .	2-4a	10
Desired fuel pressure cannot be obtained . . . . .	4-4	24	Location . . . . .	2-4b	10
Destruction . . . . .	5-3, 5-4,	39, 40	Maintenance . . . . .	3-15	19
Detailed inspection (before- operation services) . . . . .	5-5		Purpose . . . . .	2-4c	10
	3-4c	16	Gage, water temperature . . . . .	2-6, 3-14	12, 19
Dimensions and weight . . . . .	1-6a	7	Description . . . . .	2-6a	12
Drive arms, "frozen" . . . . .	3-4c, 4-36c	16, 36	Location . . . . .	2-6b	12
During-operation services . . . . .	3-5	16	Maintenance . . . . .	3-15	19
Dusty areas, operation in . . . . .	2-14	14	Purpose . . . . .	2-6c	12
Electrical insulation tape . . . . .	3-19a, b, 4-27, 4-28	21, 22, 33	Generator, power supply, external . . . . .	2-11	14
<b>Equipment:</b>			Heater control switch . . . . .	2-2	10
New . . . . .	4-1	24	Description . . . . .	2-2a	10
Special . . . . .	3-2	15	Location . . . . .	2-2b	10
			Purpose . . . . .	2-2c	10
Heating boiler, low pressure . . . . .	4-31, 4-32		Heating boiler, low pressure . . . . .	4-31, 4-32	35
Heat-reflective tape . . . . .	3-26, 3-27,		3-26, 3-27,	23	
	4-33, 4-34		4-33, 4-34	35, 36	
Hose, fuel . . . . .	3-18, 3-19,		3-18, 3-19,	21	
	4-27, 4-28		4-27, 4-28	33	

Paragraph	Page	Paragraph	Page		
Hose, water . . . . .	3-22, 3-23, 4-25, 4-26	22, 31, 32	Purpose (before-operation services) . . . . .	3-4 <i>a</i>	15
Identification . . . . .	1-6	7	Record and report forms . . . . .	1-2	2
Identification plates . . . . .	1-6, 3-24, 3-25	7, 22, 22	Reflective tape, heat . . . . .	3-26, 3-27, 4-33, 4-34	23 35, 36
Inspection, visual . . . . .	3-1 <i>b</i>	15	Relay, time delay, 2-second . . . . .	1-2 <i>i</i>	31
Instruction plates . . . . .	3-21, 3-25	22	Relay, time delay, 120- ( $\pm 35$ ) second . . . . .	4-2 <i>i</i>	31
Instruments . . . . .	2-4, 2-5, 2-6	10 12	Salt water areas, operation in . . . . .	2-17	14
Lines, fuel and water pressure . . . . .	3-20, 3-21	22	Scope . . . . .	1-1	2
Loading equipment for shipment . . . . .	5-1	39	Service upon receipt of equipment . . . . .	4-1, 4-2	24
Low-pressure heating boiler . . . . .	4-31, 4-32	35	Shipment . . . . .	5-1	39
M2 water heater does not heat water . . . . .	4-10	26	Skid assembly . . . . .	1-35, 4-36	36
M2 water heater, general descrip- tion of . . . . .	4-5	25	Snow areas, operation in . . . . .	2-16	14
M2 water heater shuts down dur- ing operation . . . . .	4-16	27	Spark arrester (in exhaust stack) . . . . .	1-5 <i>c</i>	6
M9 decontaminating apparatus . . . . .	2-9	13	Special tools . . . . .	3-1	15
M45 truck chassis . . . . .	2-10	14	Starting procedure . . . . .	2-8 <i>b</i>	12
Magneto, combustion chamber . . . . .	1-4 <i>b</i>	6	Stopping procedure . . . . .	2-8 <i>d</i>	13
Main electrical power cable . . . . .	3-16, 3-17, 4-29, 4-30	21	Storage, administrative . . . . .	5-2	39
Manual carrier, tool and . . . . .	1-19, 4-20	33	Stuffing tube . . . . .	1-30	33
Multifuel (types of fuel) . . . . .	1-6 <i>d</i> , 4-5 <i>b</i>	28	Switch . . . . .	2-2, 4-32 <i>c</i> (1)	10, 35
Nameplates . . . . .	3-21, 3-25	7, 25	Flame . . . . .	4-32 <i>c</i> (1)	35
New equipment . . . . .	4-1	22	Heater control . . . . .	2-2	10
General . . . . .	4-1 <i>a</i>	24	Tabulated data . . . . .	1-6	7
Preparation for operation . . . . .	4-1 <i>d</i>	24	Tape, pressure-sensitive adhesive . . . . .	3-19, 3-36, 4-33	21, 23, 35
Removing protective material . . . . .	1-1 <i>c</i>	24	Electrical insulation . . . . .	3-19 <i>a, b</i>	21, 22
Unloading . . . . .	4-1 <i>b</i>	24	Heat-reflective . . . . .	3-26, 3-27, 4-33, 4-34	23, 35, 36
Nozzle . . . . .	4-32 <i>c</i> (2)	35	Temperature selector valve control . . . . .	2-3	10
Nozzle holder . . . . .	1-32 <i>c</i> (2)	35	Tool and manual carrier . . . . .	4-19, 4-20	28
Operating controls . . . . .	2-1, 2-2, 2-3	10	Tools and accessories . . . . .	3-6 <i>b</i>	16
Operating personnel . . . . .	2-7 <i>b</i>	12	Tools and equipment . . . . .	3-1, 3-2	15
Operating procedures . . . . .	2-8 <i>c</i>	13	Transportability . . . . .	2-7 <i>d</i>	12
Operating under unusual condi- tions . . . . .	2-14—2-17	14	Tropic areas, operation in . . . . .	2-17	14
Operating under usual conditions, general . . . . .	2-7	12	Troubleshooting, general . . . . .	3-8, 4-9	18, 26
Operator's preventive main- tenance services . . . . .	3-3—3-7	15, 16	Operator's . . . . .	3-8—3-11	18, 19
Organizational preventive main- tenance services . . . . .	4-5—4-8	25	Organizational . . . . .	4-9—4-16	26, 27
Painting . . . . .	3-26, 3-27	23	Unusual operation of M2 water heater . . . . .	3-5 <i>b, c</i>	16
General . . . . .	4-3	24	Used equipment . . . . .	4-2	24
Paints to be used . . . . .	4-4	24	Valve, temperature selector control . . . . .	2-3	10
Panel covers . . . . .	3-13, 4-18 4-21, 4-22	19, 28	Visual inspection . . . . .	3-6 <i>a</i> , 4-5 <i>a</i>	16, 25
Performance . . . . .	1-6 <i>c</i>	7	Water heater shuts down during operation . . . . .	4-16	27
Power cable, main electrical . . . . .	3-16, 3-17	21	Water hose assembly . . . . .	3-22, 2-23, 4-25, 4-26	22, 31, 32
Power supply generator . . . . .	2-11	14	Water not hot enough . . . . .	3-11	19
Pressure lines, fuel and water . . . . .	3-20, 3-21	22	Water pressure gage . . . . .	2-4, 3-14, 3-15	10, 19
Pressure-sensitive adhesive tape . . . . .	3-26, 3-27, 4-33, 4-34	23 35, 36	Water pressure lines, fuel and . . . . .	3-20, 3-21	22
Protective clothing . . . . .	2-7 <i>c</i>	12	Water supply . . . . .	2-13	14
			Water temperature gage . . . . .	2-6, 3-14 3-15	12, 19 19
			Water too hot . . . . .	3-10	18

By Order of the Secretary of the Army:

W. C. WESTMORELAND,  
*General, United States Army,*  
*Chief of Staff.*

OFFICIAL:

KENNETH G. WICKHAM,  
*Major General, United States Army,*  
*The Adjutant General.*

Distribution:

*Active Army:*

CNGB (1)	USATTC (1)
USAMB (2)	EAMTMTS (1)
USAMC (5)	WAMTMTS (1)
USCONARC (10)	MOTBA (1)
ARADCOM (5)	MOTBY (1)
ARADCOM Rgn (5)	MOTKI (1)
USAMUCOM (5)	MOTSU (1)
OS Maj Comd (5)	Arsenals (3) except Edgewood (50)
USACDCEC (10)	USAAPSA (10)
USACDC (2)	PG (5)
USACDCCBRA (2)	Ft Knox FLDMS (10)
USACDCADA (2)	Units org under fol TOE:- 1 ea. UNOINDC
USACDCARMA (2)	3-7 (3)
USACDCARTYA (2)	3-500 (AA-AC)
USACDCAVNA (2)	9-17
USACDCIA (2)	11-216
USACDCSWA (2)	11-500
Armies (5)	17-52
Corps (3)	29-11 (3)
Div (3)	29-21 (3)
Instl (2) except	29-27
USAECFB (4)	29-37
USMA (10)	29-51
Svc Colleges (10)	29-57
Br Svc Sch (10) except	29-114 (3)
USACMLCS (60)	29-124 (3)
Gen Dep (5)	29-136 (3)
Dep (5)	29-137
Army Dep (5)	29-189
POE (1)	29-216 (3)
USAARMC (2)	29-307
USAAMC (2)	50-732
USAAPC (2)	50-747
USA Msl & Muns Cen & Sch (2)	50-946
USAIC (2)	

*AGNG:* State AG (3).

*USAR:* None.

For explanation of abbreviations used, see AR 320-50.